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Remarks and Calculations on the Best Form for Railway Bars, and on the defects which exist in the present method of supporting the same. *By* R. Stephenson, *Engineer.*

It is abundantly proved, both by experiment and mathematical demonstration, that when a beam is supported at both ends, and sustains a load, either uniformly distributed over the whole length, or placed at any point between the supports, it is of equal strength throughout, if the form be a semi-ellipsis. In practice, this form is almost invariably adopted as the most economical, giving the greatest strength with the least quantity of material, especially in cast iron, which admits of the elliptical shape being accurately given to the beam. So long, therefore, as cast iron was employed for railway purposes, the elliptical rail was adopted by common consent. The circumstance, also, of this kind of rail, when carefully proportioned, scarcely ever breaking in precisely the same part of the length, proved experimentally that the form given to them was a close approximation to that of equal strength.

On the substitution of malleable, for cast, iron for railway bars, it was considered impracticable to give the elliptical shape to the rails; the first malleable iron rails were, consequently, made parallel, or

uniform in depth, throughout the whole length between each bearing. This deviation from the elliptical form was deemed, by some engineers, a serious defect; so much so, that the extension of the use of the malleable iron for railway bars, was for some time retarded: this difficulty, however, was surmounted by an ingenious application of an eccentric roller, by which a form was produced, which, though it did not correspond accurately with the equation of the ellipse, yet approached it so nearly as scarcely to admit of any deviation being made with advantage.

Since the introduction of this form for malleable iron rails, some engineers have returned to the original parallel rail, conceiving that the application of the eccentric roller tends to destroy the uniform arrangement amongst the fibres of the iron, which in the parallel rail may be reasonably considered to extend uninterruptedly from end to end of the rail, which is, consequently, better prepared to withstand the kind of strain to which it is to be subjected.

How far this anticipation is correct, is evidently more a matter of experiment than of calculation; it may, however, be interesting, in the first place, to compare the relative theoretical strengths of the elliptical and parallel rails, on the supposition that they are of the same weight for a given distance; and afterwards to compare the theoretical deduction with experiment, which will show the dependence to be placed on the application of the formula to cases where experiment is not within reach.

It is well ascertained that the transverse strength of beams varies directly as the breadth and square of the depth, and inversely as the length. It may be represented thus, $\frac{b.\ d^2}{l}$; when b = breadth, d = depth in the middle of the length, and l = length. In comparing the parallel and elliptical rails, the breadth and length may be taken as constant; the relative strength will therefore vary as d^2. Now, if d = depth of the elliptical rail in the middle, and x = the difference of depth between the middle and the ends, (or what is usually denominated "the belly of the rail,") $d - \frac{1}{2}\,x$ will be, nearly, the depth of a parallel rail of equal weight; the relative strengths of the two rails will therefore be as $d^2 : (d - \frac{1}{2}\,x)^2$, or, $1 : \frac{(d - \frac{1}{2}\,x)^2}{d^2}$.

The last fraction is clearly less than 1; consequently, the strength of the parallel rail must always be less than the elliptical, and will depend on the magnitude of x, or the swell of the rail.

In the view just taken, it will be observed that the projecting ledge on each side of the vertical rib, forming the surface of the rail, has made no part of the consideration, because it is common to each kind of rail. It is not difficult to introduce it, but it would add to the intricacy of the formula, and would give a result a little more in favour of the elliptical rail, as it would elevate the neutral axis, and thus operate in favour of that rail which has the greatest depth.

The above formula applies merely to a vertical pressure; but as

railway bars are also subject to severe lateral strains, it may be well to point out, in this respect, where the elliptical rail still has the advantage.

A lateral strain upon a railway bar is evidently nothing more than a vertical pressure, if the rail be supposed laid upon its side; the same formula then applies, making b and d change places; for what was the breadth in the former case, now becomes the depth, and as the depth and length are supposed the same, the relative strengths will be directly as the breadths; that is, as $b : (b - \frac{1}{2} x.)$

These results are, however, only applicable to the calculation of the ultimate strength; but in considering the relative advantages of railway bars, the ultimate strength of which ought, in all cases, far to exceed the working strain, it would appear that the quantity of deflexion, rather than the breaking load, ought to be the measure of their comparative merits.

It will be readily admitted, on a little consideration, that great, if not absolute, rigidity is extremely desirable in a railway bar; and, though it may be impossible to attain this object, we are justified in making every effort to approach it, by adopting that form of rail which possesses the greatest stiffness, with the least quantity of material. It is in this respect that the increased depth of the rail, obtained by making the longitudinal section a semi-ellipsis, produces a very sensible advantage, and places the merits of the latter form in a much stronger light, than the comparison of the ultimate strengths.

The stiffness, or rigidity, of beams has been proved by Barlow, Young, Tredgold, and others, by a great variety of experiments, to vary directly as the breadth and cube of the depth, and inversely as the cube of the length. When, therefore, the lengths and breadths of the two beams are the same, the relative stiffness will be as the cube of the depth only. Now, the depths at the middle of an elliptical and parallel rail of the same weight, have already been stated to be as $d : d - \frac{1}{2} x$. The relative stiffness will therefore be as $d^3 : (d - \frac{1}{2} x)^3$, or as $1 : \frac{(d - \frac{1}{2} x)^3}{d^3}$, a proportion much more in favour of the elliptical rail, than that previously stated as representing the ultimate strength.

This ratio, it must be observed, requires modification, owing to the circumstance of a parallel beam being more rigid than an elliptical beam of the same depth in the centre; this deduction, however, is not such as to interfere in a great degree with the result indicated by the formula, as will be shown by the experiments adduced in the sequel of these remarks.

In determining the form of railway bars, little, if any, attention has been paid to the question of deflexion; it appears, therefore, the more necessary in this instance to consider its effects, as it is apprehended that it is productive of several injurious consequences, which have hitherto been attributed to a wrong cause. The usual method of uniting the rail chairs and blocks, by keys and pins, tends clearly to form the whole into an inflexible line, no one part being capable

of changing its position, without producing a corresponding change, or distortion, in the adjoining one. Immediately, therefore, on the slightest deflexion taking place in the rail between the supports, the position of the key which connects the rail and chair is disturbed, as it necessarily has a tendency to assume the same angular position as the rail. If this tendency is resisted by the grooved recess in the chair, for the reception of the key, the effect is merely to transfer the tendency from the key to the chair, which is thereby made to rest on one side, or arris, of its base, and on the other alternately. This continual transfer of strains from the rail to the key, from the key to the chair, and, finally, from the chair to the block, or sleeper—originating from the deflexion of the rail—never fails to destroy one or both of these connections; thus giving rise, not merely to perpetual expense in replacing keys, but to a continual jarring noise when carriages pass over them, from the looseness of the rail and key in the chair. Now, it being absolutely impossible to make the rail between each two supports perfectly inflexible, it seems only reasonable to conclude that every attempt to connect the parts, so that one portion of the structure partakes, in a greater or less degree, of the movements of the adjoining one, must be abortive. This is on the supposition that the inevitable deflexion in the rail is the only source of derangement; but when we add to this, the constant settling of the foundation upon which the blocks are placed, as well as the unequal yielding of the same, which destroys the parallelism between the surface of the rail and the bed of the block, the consequences just alluded to present themselves with increased force.

These reflections appear to countenance the conclusion that much advantage would be derived from the adoption of some method of connecting the rail and chair, which would admit of deflexion in the rail, as well as a change in the position of the block, without destroying the accuracy and efficiency of the connections.

A model of rail and chairs, contrived with the view of obviating the imperfections arising out of what may be termed the "inflexible" plan of connecting the rail and chair, accompanies these remarks. The method described by the model is not affirmed to be free from objection, but is suggested as much less objectionable than the method usually followed, and may be regarded as a step towards that perfection which, it is hoped, will, ere long, be attained in this very important part of the construction of a railway.

If the view here taken be correct, that is, if the deflexion of the rail is one of the principal causes of the present rapid working loose of the rails, keys, and chairs—which would continue to be the case, even after the road has obtained a firm and solid foundation—it is evident that, in order that the quantity of deflexion may be diminished, a stronger rail than has been hitherto employed, is desirable, independent of any consideration in reference to increased weights to be conveyed.

The next, and perhaps the most apparent, cause of derangement in the accuracy of a railway, is the yielding of the material which supports the road; and as the practical operation of this shrinkage

points to a comparison between the parallel and elliptical rail, it may be well to direct attention to it in an especial manner.

When a malleable iron railway bar is first laid and adjusted, each support throughout the five yards, (the ordinary length of each rail,) may be considered as duly performing its part. Immediately on any of the intermediate supports yielding, or falling below the general level, from the unsoundness, or from the consolidation, of the ballasting, the block is forced, by the superincumbent weight, deeper into the ground; as soon as the weight has passed over, the elasticity of the iron (which is not destroyed) causes the surface of the rail to resume its original level; it cannot, however, do this, without lifting the block from the bed, or foundation, into which it was forced, during the progress of the weights along the rail. This effect is not perceptible, until the operation has been frequently repeated; but it is easy to perceive that, as long as the elasticity of the rail remains perfect, and the solidity of the foundations of the road imperfect, the operation of alternately forcing the block deeper into the ground, and suspending it by the elasticity of the rail, must, as a necessary consequence, be going on in every railway where long malleable iron rails are employed, with several supports under each rail. It is obvious that each block so lifted, (on weights being passed over the rail,) must be forced as by a violent blow upon the foundation, thus rapidly accelerating the sinking of the ballasting, and the destruction of the parts, when once allowed to become defective. Now, the tendency to the operation just described, can only be counteracted by increasing the weight of the blocks, and diminishing the elasticity of the rail at the point of bearing; it is, however, impracticable to adopt either of these expedients to an extent that would, in a material degree, approach to the removal of the effect, because any feasible increased weight of block is inappreciable, when compared with the elasticity of the rail. The effect is mentioned in this place, merely to prove that the reduction in strength at the point of support ought not to be looked upon as a defect in the elliptical rail; indeed, it may be made to appear that such a reduction is desirable, rather than the contrary: it will, therefore, be necessary to show that these observations respecting the suspension of the blocks, and the rapid succession of violent blows, like that of a ram, upon the ballast, are not merely ideal.

This is forcibly illustrated by a comparison of the expense of keeping malleable and cast iron railways in order, the latter scarcely exceeding one-half the former, and in some cases (if report is to be received) rather less than that proportion.

It may, perhaps, be objected, that a comparison between cast and malleable iron, on different railways, is not a suitable criterion, as the traffic and speed may be so far different as to account for the difference of expense; this objection is, fortunately, not tenable, as applied to the Darlington Railway, because there the cast iron rails are placed on an embankment, over which the traffic and speed are the same as on other parts of the line. Here the comparison is decid-

edly in favour of the cast iron, and, as I have been informed, in about the proportion above stated; and, although I have not been able to obtain an exact detail of the expenses of each, the chairman of that railway company informed me that, after careful and minute examination, he had completely satisfied himself on the point, and as it corroborates my own observations, I am led to regard it as a well established fact. The only difference in construction between the two descriptions of rails, consists in the cast iron rail having a flexible joint above each support; when, therefore, the foundation sinks, the blocks sink with it; but, there being no reaction, from the elasticity of the rail, the blocks never become suspended; consequently, the ram-like action is never called into play. This leads to the conclusion, that flexibility above the supports is not so weighty an objection to the elliptical rail as has been imagined.

It has been sometimes urged as an advantage in favour of the parallel rail, that the great strength above the supports enables it to sustain the load, even though the block may have sunk below the original level. If this be true, it appears to amount to little more than an admission that it is unnecessarily strong when supported by the blocks, which it in fact always is, because the deflexion of any railway bar of the ordinary strength, where the supports are six feet apart, would be so great as to render rapid velocities more destructive than they are; for the deflexion, being directly as the cube of the length, would be eight times greater than where the rail is supported at every yard; moreover, the supports of a railway should never be allowed to assume that condition, in which one-half of the blocks are supposed to become useless. Preparing, therefore, by the adoption of parallel rails, for circumstances which it is not only practicable to avoid in a public line of road, but ought never to be allowed to take place, appears at least unnecessary; but when it is recollected, in addition to this, that the material thus expended in adding strength to the rail, above the supports, may be applied to other parts of the rail, where strength is more required, it certainly increases the inducement to follow the elliptical form.

The difficulty of manufacturing, and a proportionate increase of expense in, the elliptical rail, have, it is believed, been the principal causes of its rejection by some. To these I have endeavoured to give the most impartial consideration; and with respect to the difficulty of manufacturing, if any really exist, I am convinced it arises from inexperience, as the operation consists, in addition to the rolling of ordinary bar iron, of merely once or twice passing it through the rollers by which the elliptical shape is given. That this should be considered a difficulty, creating an objectionable expense, is somewhat remarkable, since it occupies but a few seconds.

It is not improbable that the true source of this objection, (which arose originally, I believe, with some iron-masters,) is to be found in the fact that it is difficult, if not impracticable, to introduce into the elliptical shaped rail, iron of inferior quality, as the nature of the process almost invariably detects it. This is a recommendation so palpable, that an endeavour has been made to countervail it, by stat-

ing that the process by means of the eccentric roller destroyed the continuity of the fibres, and injured the strength of the rail. Experiment, of course, is our best guide, and on referring to this test, it does not countenance the supposition that iron, of the best quality, is sensibly injured by the process of rolling into the elliptical form. An examination of the table hereafter referred to, will be a sufficient reply to this objection.

[TO BE CONTINUED.]

Experiments, made to determine whether Light exhibits any Magnetic Action. By JOHN W. DRAPER, *Christiansville, Mecklenburg Co., Va.*

"The more refrangible rays of light are said to possess the property of rendering iron and steel magnetic. The existence of this property was first asserted by Dr. Morichini, of Rome. Other observers subsequently failed in obtaining the same results; but in the year 1825, the fact appeared to be decisively established, by the learned and accomplished Mrs. Somerville, in an essay published in the Transactions of the Royal Society. In her experiments, sewing needles were rendered magnetic, by exposure for two hours to the violet ray, and the magnetic virtue was communicated in still shorter time, when the violet rays were concentrated, by means of a lens. The indigo rays were found to possess a magnetizing power, almost to the same extent as the violet, and it was observed, though in a less degree, in the blue and green rays. It is wanting in the yellow, orange, and red. Needles were likewise rendered magnetic by the sun's rays, transmitted through green and blue glass. These results have been verified by M. Zantedeschi, of Pavia, (Bibl. Univ. for May, 1829,) but their accuracy has been doubted by Messrs. Riess and Moser, who consider that the means employed by Mrs. Somerville, for ascertaining the magnetic state of the needles, were not sufficiently exact. They found the oscillation of needles to be wholly unaffected by exposure to the prismatic colours, (Brewster's Journal, 2, p. 225, N. S.) This must still be regarded, therefore, as one of the disputed points in science." (Turner.)

It has been supposed that this disparity of results arose entirely from local circumstances. A hazy atmosphere, such as is met with in the northern and middle countries of Europe, might perhaps influence, in some manner, this peculiar property of light, when the clearer sky of Italy allowed an opportunity of making the experiment. Some indeed have thought that the observers who were said to have verified the original results of the Italian philosopher, were themselves deceived, in not having previously ascertained the magnetic state of the needles they used. That mistakes of this, and a similar kind, are easily made, will appear in the course of this communication.

During the past summer, I have attempted to satisfy myself whether the more refrangible rays really exert any magnetic influence,

and happening to reside in the south of Virginia, upon the same parallel of latitude as Tunis, and the more northerly African kingdoms, I thought the situation too favourable to suffer such an opportunity to pass, without endeavouring to gain some decisive information on this contested point.

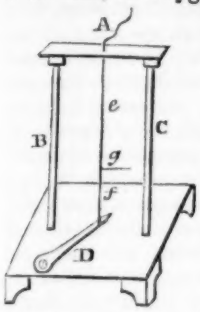
The sky of that part of Virginia is not, however, so bright as might be expected. When unclouded, it is of a clearer blue than the sky of England, and, I think, rather darker, approaching, by several shades, nearer to the tint of Prussian blue, than that azure colour which it has in the latter country. During a residence of twelve months. I saw it twice of that intense complexion which they say it has in the tropical regions. The moon appeared globose, and her centre to bulge out like a ball, and the planet Venus might be fancied to exhibit a well formed crescent. The air passes from great moisture to dryness, with rapidity; a good barometer is seldom at rest. The temperature of the sun-beam is sometimes 132 F., but the syphon barometer seldom varies more than one inch. Clouds form and rise with great rapidity, the seasons are uncertain, and the atmosphere is often deformed with a mistiness that obscures distinct vision. But the dense clouds that gather in the west, of an evening, emulate the beauty of a sunset on the Atlantic ocean.

I am thus particular in describing the state of the atmosphere in which these experiments were made, because much stress has been laid upon that circumstance, as materially affecting the results of magnetic action of the solar ray. And, as the experiments now to be detailed lead to a negative decision, it is well to explain under what circumstances they were performed, that those who have come to an opposite conclusion may have an opportunity of pointing out whether it is really owing to the state of the atmosphere.

In the year 1824, Mr. Christie found that a needle, six inches long, contained in a brass compass box, with a glass cover, suspended by a hair, and made to vibrate, alternately shaded and exposed to the sun, came to rest much sooner in the latter, than in the former, case. That this was not occasioned by an increase of temperature, was proved by the needle vibrating more rapidly, when its temperature was raised by other means.

In repeating this experiment, I very quickly found that it depended, in a great measure, on the nature of the suspension of the needle, and its position with respect to the incident light, what results would be obtained. If the needle was suspended on a point, or by a thread, without torsion, both the time of vibration, and the number of the whole, were the same, whether the needle was exposed to the sun-beam or not. But, if the needle was suspended by a hair, or other organic substance, having torsion, the sun-beam would occasion a degree of twist in the hair, on its first exposure to light; and if the direction of that twist happened to coincide with the direction of the needle's motion, of course the momentum of the needle was increased, and the vibrations continued longer. A needle which vibrated forty-four times in one minute, would occasionally, owing to this cause, vibrate nearly forty-six, when suspended by a hair; but if by a silk

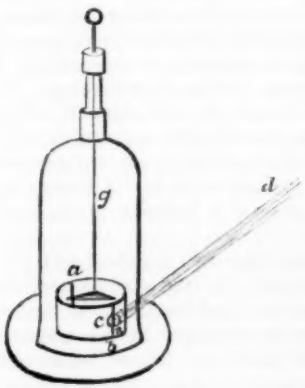
fibre, its vibrations were always forty-four; the first arch of vibration being, in every instance, 40°. That this action was due to a twist of the hair, as a hygrometric body, I ascertained by means of a simple arrangement. To a brass cross-piece, A, supported on a stand by two pillars, B C, a hair, *e*, was fastened, about the point A; its other extremity, *g*, being fastened to a whalebone spring, D, by a thread, *f*; the extremity, *g*, of the hair, being bent by the knot on one side, served as an index. On exposing the instrument to the sun-beam, the little index, *g*, immediately moved, sometimes more than a semicircle.



Thinking to obtain more decisive effects, I concentrated the sun-beam with a lens, on the south pole of the suspended needle, and found that the needle was thrown into a rapid, tremulous motion. But here the hot air ascending from the needle, acts upon it as upon the sail of a windmill; and the same effect ought to take place, to a certain extent, on simple exposure of the half of a vibrating needle, to direct light. But I found that a needle suspended in the vacuum of an air-pump, by a thread without torsion, is in no way affected by exposure to solar light.

Ex.	Length of needle in inches.	No. of vibr. in shade.	In the sunbeam.
1	$1\frac{1}{2}$ sewing needle	44	44
2	2 blue spring	32	32
3	$3\frac{1}{8}$ do.	26	26

Therm. in the sun, 109 to 105.—Barom., 29.3.—Duration of Exp., 60′



It is said expressly, in the account of Christie's experiment, that the needle was contained in a brass compass box. It might have been, that electrical currents were excited in that box, which was the cause of the derangement in question; I therefore vibrated a needle, under similar circumstances, with the same result as above stated. I should mention that this was done in a solid cylinder, or ring, of brass, without any seam, or soldered junction; but as compass boxes are generally made of sheet brass, with a soldered seam in the side, it was barely possible that the fine line of solder acted with the brass, as a thermo-electric couple, capable of excitation by

the warmth of the sun-beam. I therefore made a compound cylinder of copper and zinc, *c z*, the edges of which, at *a* and *b*, were neatly soldered, the junction *b* being highly polished, and that at *a* blackened. The needle was suspended in an exhausted receiver, by a silk fibre, *g*, and a ray of light, *c d*, coming from an aperture half an inch wide, in the shutter, fell upon the junction. The needle used in this experiment was of watch-spring; its first vibration was performed in an arc of forty degrees, and when the compound cylinder was taken away, it made thirty-two vibrations in sixty seconds, in vacuo. On placing it concentrically with the compound cylinder, and suffering the ray to impinge on the polished junction, the moment that the arch of vibration had become forty degrees, the number of oscillations in one minute was carefully observed; six experiments gave severally the number thirty-two. On turning the blackened junction to the light, the result was still thirty-two; and on substituting the solid brass cylinder, three consecutive trials gave thirty-two. The thermometer stood, in the sun-beam, at 103—the barometer at 28.8.

By some, this magnetic action of light has been attributed to the violet, or more refrangible rays only. A needle made of watch-spring, about four inches long, which, in an exhausted receiver, suspended by a filament of silk, exhibited no polarity, had one-half of it exposed to the violet ray, cast by an equi-angular prism of flint glass. This ray was separated from the others by passing through a slit in a metallic screen, and half the needle shielded from its action by a piece of paper. After two hours' exposure to the sun, it was suspended again in the exhausted receiver, but still showed no token of polarity; it was then exposed to the other rays, successively, with the same result. The needle was now slightly touched, and, slowly vibrating, arranged itself along the magnetic meridian. The first vibration was performed in a semicircular arch, and the number of vibrations performed during one hundred oscillations of a second's pendulum, was 27. But, after four hours' exposure to the violet ray, as before, no evidence of any change, either increasing or diminishing the number of oscillations, could be gained. A column of violet light, passing through a disk of stained glass, was concentrated on one end of a sewing needle, by means of a lens, without producing any change in the number of vibrations it made in one minute. This needle, on some occasions, however, would give uneven results; when its first vibration was performed in a semi-circle, the number varied from forty-one to forty-three, in sixty seconds. On vibrating it in vacuo, its results uniformly gave the latter number, very nearly.

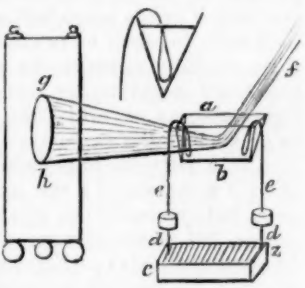
The position of the needle to the incident ray, is not of any consequence; whether it receives it obliquely, in the direction of the light, or across it. If soft iron be substituted for steel, the results are still negative, even if the needle be arranged in the magnetic meridian, the line of dip, or any other position. I therefore come to the conclusion that the violet ray, as developed by a prism of Eng-

lish flint glass, possesses no influence on the magnetic needle, and all the other rays are equally inert.

But, as Mrs. Somerville found that a needle placed under a piece of glass, or blue ribbon, having half its length protected by paper, became, in a short time, magnetic, I tried the same experiment; but, in every instance, failed in making the needle magnetic. When suspended by a silk fibre, in vacuo, needles showed no disposition to arrange themselves in any particular line, and when they came to rest, they were found cutting the magnetic meridian at every angle, although the temperature of the sun-beam to which they had been exposed, on one occasion, was 124° F. Great care was taken to ascertain the previous non-magnetic state of the needles, and they were suspended by a fibre without torsion. To ascertain whether any thing was due to the nature of the medium, I substituted prisms of water, alcohol, spirit of turpentine, and other essential oils, with the same results.

These are the means by which, it is said, the magnetism of light was first discovered; but there are much more delicate methods of detecting such an action, if it existed, and to them, in the next place, I resorted. For, if the violet, or other rays of light, exercise an influence on the magnetic needle, that action must be mutual between them, and the light, in its turn, should suffer a derangement. To ascertain this, I admitted a divergent beam of light, through a hole in the shutter of a dark room; the cone of luminous matter, at its apex, was about $\frac{1}{10}$th of an inch in diameter, and a hair, or other filament, held in it, exhibited the phenomena of diffraction, the colours being received into the eye, by a lens. Across this beam, a silver wire was adjusted, each of its extremities connected with cups of mercury, which communicated with the poles of a voltaic battery. It was expected that, if there was any action between a magnetic filament and light, some derangement would be seen in the diffracted fringes, when the current passed; but none such was observable.

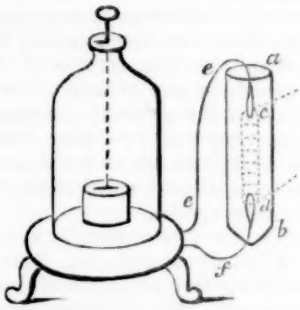
Again, two wires were so adjusted that they could be made to approach or recede from each other, by a screw movement, and voltaic currents be passed in either direction, up or down them, conjointly or separately; when they were within the $\frac{1}{150}$th part of an inch, the fringes they produced were very perceptible, but the passage of the current caused no alteration whatever. These experiments were also repeated in homogeneous light, with the same results.



A hollow prism, *a b*, for containing transparent, but imperfectly conducting, liquids, was traversed by a voltaic current, from the battery, *c z*, by means of platina wires, *e e*, one extremity of each of which went to the bottom of the liquid, and the other dipped into the mercurial cups of communication, *d d*. A ray of light, *f*,

passed through the prism, and was refracted on the screen, *g l*, or viewed by a glass. Some of those lines which traverse the spectrum, were at times visible; but neither these, nor the spectrum itself, suffered any perceptible alteration during the passage of the current.

Some philosophers have pointed out the different degrees of temperature which Sir W. Herschel detected in different parts of the prismatic spectrum, as analogous to that increase of temperature which takes place in the cells of the voltaic battery, as we proceed from the negative to the positive pole. Hence, they have supposed that each end of the spectrum was in an opposite electrical state. With the analogy I have nothing to do; but to ascertain whether the deduction from it is founded in fact, I made this experiment. I received into a tube, *a b*, filled with acidulated water, the whole of the prismatic spectrum, cast by an equiangular prism of English flint glass, in that part, *c*, which was covered by the violet ray; I immersed one wire, *e e e*, of a galvanometer, arranging the other wire, *f f*, in that part, *d*, which received the red ray. Alternately placing and withdrawing the arrangement from this position, it was to be expected that either a continuous current, or a wave, of electricity, would pass along the galvanometer wires, producing either a permanent or transient disturbance. I was not able, however, to notice such an effect; and suspecting that, if any electricity was developed, it might be of such low intensity as to be unable to pass through acidulated water, I repeated the experiment, using, instead of the tube of water, a piece of polished tin, in the shape of a parallelogram, three inches long, and one broad, to each end of which the galvanometer wires were soldered; but the results were still negative.



The general termination of these experiments would lead us to suppose that, if there be any reaction between galvanic and magnetic currents, with solar light, they are of such a nature as to forbid repetition in latitudes as far south as 35°. Or, the atmosphere of southern Virginia is too loaded with vapour, and too much obscured with mist, to admit us to distinguish any such effect. But, perhaps, if we carefully consider the nature of light, we may receive much assistance in developing that action which really takes place, when light impinges on all bodies, and hence we may draw an argument to prove that the magnetic action of a ray of the sun, or any other star, is a physical improbability. Now, we usually consider a ray of light to consist of a vast number of particles, of excessive smallness, but, nevertheless, of absolute size, which move with an immense, but measurable velocity. Many arguments might be brought to prove that these particles are non-conductors of electricity, and, perhaps, are the best non-conductors, of any thing we know.

It is an indisputable fact that, whenever one body touches another, the electric equilibrium of the system is disturbed, and as the particles of light obey those laws of attraction at small distances, or capillary action, in common with all other matter, there is no reason that they should depart from a law which bears upon every thing else. I have heretofore shown that capillarity is referable to nothing more than electricity, upon approximation, and that all the phenomena of the former are explicable by the laws of the latter. These considerations lead me to expect that a column of light cannot fall upon the surface of a disk of glass, without a total derangement of the electric equilibrium of the whole system.

[TO BE CONTINUED.]

NOTES OF AN OBSERVER.

Remarks on Professor Olmsted's Theory of the Meteoric Phenomenon of November 12th, 1833, denominated Shooting Stars, with some Queries towards forming a just Theory. *By* JAMES P. ESPY.

(Continued from p. 16.)

Let us now see if the observations recorded furnish any data, from which we may be able to estimate the height of the meteors. I think they do, and that we shall succeed in showing, with absolute certainty, that, in many places at least, the meteors could not have been ten miles high. If they had been so high, all those observers who were within fifty, or even a hundred, miles of each other, would have seen many meteors in common, and, of course, would have seen the phenomenon commence at the same time, and, also, the radiating point in the same direction.

Such, however, was not the fact in very many instances. At New York, by one o'clock, the discharge was almost incessant, and at two, the whole heaven was streaked with fire,—whereas, in Long Island Sound, the pilot of the steam-boat Providence says he watched the spectacle from its commencement, about three o'clock in the morning, till it disappeared in the light of the sun,—whereas, in Haverstraw Bay, North River; about thirty miles from New York, Capt. Seymour, though he saw an unusual number of shooting stars, principally in the east, about half past twelve, did not notice any surprising splendour in the scene till half past two o'clock—an hour and a half later than it appeared at New York.

But, what is more remarkable still—between these two points, in Tappan Bay, Captain Faurot saw, between *eight and nine o'clock*, as frequently as once a minute, common shooting stars, coursing against the wind, to the south-west by west, or west-south-west. They rose mostly in the north-east, and those which started down in the south-east, were very short. About midnight, the stars became too numerous to be counted, but maintained the same general course, to the west of south-west. Between twelve and one o'clock, the trains were longest and most brilliant—though more numerous afterwards. At West Point, Mr. Twining saw the radiant point only a few degrees

south and east of the zenith. whereas, all the way from Haverstraw Bay to New York, Captain Seymour saw the radiant point not more than forty-five degrees high in the south-east.

These places being near each other, and the phenomena exhibited being so very different, the conclusion forces itself upon us, that the different observers did not see the same meteors, which they must have done, if the meteors had been even ten miles high.

Again, at Boston the meteors fell perpendicularly to the horizon, and at Concord, New Hampshire, they moved from the horizon towards the zenith, and in every other direction. As to the splendid aurora and triumphal arch seen at Dover, N. H., not a word is said of it at Concord; and it certainly was not seen at Boston, unless it was there in the form of a "vapour round the horizon, which, in the south-east, assumed a very beautiful appearance during ten minutes, half an hour before sunrise." Now, as Dover is not more than sixty miles from Boston, this auroral arch could not be more than two miles high, or it would have been seen several degrees above the horizon there. And as it is not mentioned as having been seen at Concord, twenty-five miles from Dover, the probability is, that it was not, and if so, its height must be diminished down to less than a mile. Again, the beautiful appearance seen at Boston, in the south-east, could not have been fifty miles from Boston, or it would have been nearer Providence than Boston; but Professor Caswell says no auroral appearance was seen at Providence. And, what is more worthy of remark still, is, that the remarkably bright auroral light seen by Mr. Palmer, at New Haven, constantly in the east, as high as seven or eight degrees, was not seen at Providence at all, which it must have been, very distinctly, if it had been two miles high. Again, at Matanzas, Cuba, the meteors fell perpendicularly, and at the distance of less than forty miles out at sea, lat. $23\frac{1}{2}$, long. 32, the ship Tennessee was in view of the meteors on every side, from four to six o'clock. *They seemed to follow the direction of the wind, which was east-north-east.*

These observers could not have seen the same meteors which they would have done if the meteors had been ten, or even five, miles high.

At sea, off Charleston, S. C., the meteors commenced at nine o'clock; whereas Captain Parker, of the ship Junior, on the west side of Florida, who was observing, at a little before three o'clock, saw several meteors, but *not more* than he had often seen before; but about three, the number increased so rapidly, that he could not count them. Nor is there any regularity in the time of beginning. At Union Town, Pa., the meteors were but few at half past four, but rapidly increased till five; and at Poland, Ohio, the maximum was from two to three, or two hours before they appeared at all at Union Town. Off Charleston, S. C., and in the North River, they appeared more than seven hours before they appeared at Union Town.

At St. Augustine, about half way between Charleston and the ship Junior, the meteors commenced about four and a half hours after their commencement near Charleston, at sea, and about half an hour

before they appeared to Captain Parker. It will be interesting to compare a few of the phenomena as they were seen by Captain Parker, on the west of Florida, and by Captain G. S. Drane, at St. Augustine, about 260 or 280 miles apart, from which I think it will appear that nothing was seen in common.

Captain Drane's account, with others at various military stations in the United States, has been kindly furnished to me by Professor A. D. Bache, of the University of Pennsylvania. At St. Augustine, the meteors were equal on all sides, falling nearly perpendicularly to the horizon, from a point a few degrees north-east of the zenith. To Captain Parker they all appeared in the north-east, not one more than forty-five degrees high; at least till half past four o'clock, when some began to pass to the south-west. At St. Augustine, it was perfectly clear and calm—to Captain Parker there appeared heavy dark clouds, hanging low, in the north-east, exactly towards St. Augustine, from which the Second Mate saw the first meteors break like lightning, and there was a light wind from the cloud.

At St. Augustine the colour of the meteors to the west was white, those to the east were tinged with the rosy hues which precede the rising of the sun;—to Captain Parker no prismatic colours were visible.

Captain Parker says, though all the meteors, both great and small, left luminous traces, no one of these traces was observed to continue visible more than two seconds;—whereas at St. Augustine, when the meteors were falling in their greatest numbers and brilliancy—at the very time when the mate was watching the phenomenon with intense interest—a vivid flash of light burst suddenly from the point where the meteors emanated, and, winding its course slowly along, assumed the fantastic shapes of 5 and 2. During fifteen or twenty minutes, this luminous spot continued to be visible, gradually spreading, and diminishing in intensity, until it was confounded and lost in the bright azure of the sky. Now this cloud, which, in all probability, was connected with the meteors which were seen to dart from it in all directions like lightning, could not have been four miles high, or it would have been several degrees above the horizon at St. Augustine, and so careful an observer as Captain Drane, could not then have described the atmosphere as "very clear, and entirely free from clouds."

There is another circumstance which renders it extremely probable that the meteors were not more than two or three miles high, and that is the angular velocity of the luminous clouds formed by the trains which they left in their passage through the air. The Professor himself seemed to be aware of the force of this circumstance; for after calculating the height of one meteor, supposed to have been seen by himself and Mr. Tomlinson, to be thirty miles at the moment of its explosion, or nearest approach to the earth, he says, "the cloud moved eastward with a very perceptible progress, equal to that of an ordinary cloud a mile high, carried by a breeze of ten miles an hour. But, in order to move with such an apparent angular velocity at the height of thirty miles, it must have had a real motion of

300 miles per hour." He might have added, also, that the upper part of the train must have had a velocity of more than 600 miles per hour. But he goes on to observe that "the improbability of such a velocity would lead us to believe that the place of explosion was comparatively near the earth."

I would add to the Professor's remark, that it is highly improbable that the same meteor was seen by the Professor and by Mr. Tomlinson; for the Professor's "meteor was seen fifteen minutes before six, and Mr. Tomlinson's thirty minutes before six, or a few minutes more or less."

I will add here, also, that it is highly improbable, if not absolutely impossible, that the meteor seen by Mr. Tomlinson, and that seen by Captain Seymour, was the same.

The observations of these two gentlemen, being supposed to belong to the same meteor, are used, with others, to calculate the height of the meteors, by Mr. Twining. Now, Capt. Seymour, with watch in hand, observed the train to continue straight for four minutes—whereas the train of the meteor seen by Mr. Tomlinson retained its rectiliniar form but a few seconds. In the course of a minute—others think as many as three or four minutes—it had assumed shapes like the figures 2, 3, 4, and 5. As this description cannot possibly apply to the other, it is highly probable that the meteor seen by the one was not seen by the other, for they were both looking at the heavens at the same time, and if so, it forms a strong presumption that the meteors were very low, not five miles high.

But if the meteors were really low at the time of extinction, to which opinion the Professor seems strongly to incline, and for which I have yet an indubitable proof to adduce, there is one conclusion of which he did not seem to be aware, and that is, the upper extremities of the meteor's visible path was comparatively low also. And this is incompatible with the Professor's theory; for a light body could not fall far into the atmosphere with the velocity of the meteors, without producing ignition, if it produced it at all by condensation of the air.

To conclude the evidence on this point, I assert, that those meteors which were heard to make a cracking, or whizzing, noise, or a noise like a pop-gun, or like birds flying through the air, or like the explosion of loose gunpowder, could not have been many hundred yards from the observer—certainly not half a mile. Now, the evidence that such noises were heard, cannot be doubted by any one unbiased by theory. Who could doubt, if there had been no other witness, than so patient and minute an observer as Mr. Palmer? could he be mistaken on this point?

"He heard, at different times, a number of slight explosions, which usually resembled the noise of a child's pop-gun and was not unlike that of a fire-rocket. They were followed by a peculiar odour, observed by all the company, (four men) which one compared to the smell of sulphur, and another to that of onions. The meteors which afforded these sounds, all passed along in a north-west direction.

"They severally afforded so much light, that Mr. Palmer could distinguish the colour of a man's beard. They passed below the tops

of the trees, at the distance of twenty-five rods from the place where he stood, giving a pop just before they reached the trees. One appeared to strike the barn, and gave a louder pop than any of the others."

We may remark on the account here given, that Mr. Palmer was most undoubtedly under the impression, at the time of observation, that the sounds which he heard, corresponded with the distances at which he then supposed the meteors to be from him. Indeed, so intelligent an observer must have formed his idea of their distance, more from the length of time which the sound took to reach his ear, than from sight, which is liable to be deceived. This circumstance alone, I think absolutely decisive of the great proximity of those meteors, at least, which were heard by Mr. Palmer.

It may be asked, why did not all hear noises who listened for them in silent situations? The answer is easy: Mr. Palmer, and those with him, heard only a few, and all *those* made that kind of sound which is never heard many hundred yards—and in nine places out of ten, the meteors might not have approached near enough to the surface of the earth, for such sounds to be heard; and even if they did, not one out of a thousand might happen to be sufficiently near the observer. And yet sounds were heard at a very considerable number of places—at New Haven, New Britain, New York, Richmond, Charleston, S. C., St. Marie, Mo. Ter., Fort Jackson, Lou., Fort Leavenworth, Ark. Ter., Fort Oglethorpe, Geo., Fort Moultrie, S. C., and Fort Jesup, Lou. At all these places, with the exception of Charleston and Fort Moultrie, just such a sound is described as could not be heard many hundred yards.

Off Charleston, a meteor of extraordinary size, was observed at sea, to course the heavens for a great length of time, and there explode with the noise of a cannon. At Fort Moultrie, some of the noises were hissing, some like the discharge of a musket, and one as loud as a six pounder. Now, who can say, in our present state of ignorance of the cause and nature of these meteors, that even these extraordinary and insulated cases are either impossible or incredible?

At all events, the evidence of a hissing noise is too respectable to be doubted; and this settles the question of their very near proximity to the surface of the earth at the time of explosion; and, for reasons assigned above, proves positively their atmospheric origin. These two positions, then, I hope I may be permitted to say, have been established—*that the meteors were not gravitating bodies, falling towards the earth by the force of gravitation*—(not even those which fell perpendicularly, much less those which moved horizontally)—and secondly, *that they were of atmospheric origin.* I hope it will be considered a matter of some importance to have these two points *established*, and not merely *conjectured*. For, the mind being freed from wild speculations and visionary theories, as to their *celestial* or *volcanic* origin, will be left at liberty to seek for their true cause in the atmosphere, where they undoubtedly take their rise.

And here I cannot avoid repeating what I hinted at before, that many circumstances render it highly probable that the meteors in

question, and the aurora borealis, have one common origin. They have both now been demonstrated to be low in the atmosphere, (see Journal of the Franklin Institute, vol. xiii. p. 294)—they are both frequently attended with hissing or snapping sounds*—there are very often a great many *meteors* on nights of aurora—and on the night of these meteors there were a great many auroras. Indeed, I would suggest that many of the auroral appearances which were exhibited that night, were these very meteors themselves. The bank of auroral light, resembling day-break, which was observed by Mr. Palmer at New Haven, and the vapour in the atmosphere, visible round the horizon at Boston, which assumed a very beautiful appearance in the south-east, an hour before sunrise—might be the meteors themselves, too far off for any *one* to be distinctly visible, and yet, by their combined influence, producing a luminous appearance. So the auroral or boreal light, which appeared at Cincinnati a little north of east, the lower edge of which was several degrees above the horizon, was possibly owing to the same cause.

Once more, the twilight which was seen by Mr. Twining at West Point, between five and six o'clock, issuing from the whole south-eastern and southern, while the western and northern quarters were as dark as usual—might depend on the difference in the number of meteors which fell in those different directions. This fact might, perhaps, be yet ascertained.

Finally, on this point, the difficulty is, that luminous appearances were not exhibited at all places where the individual meteors were not seen to approach to the earth nearer than fifteen or twenty degrees; for remote meteors certainly did fall lower than that, and though their light might not be strong enough to make a distinct impression of their individuality through so great an extent of atmosphere, yet it would seem that their combined influence should have been sufficient to produce a sensible illumination. Perhaps this illumination was too faint in most cases, in comparison with the splendour above, to attract particular notice, even where it actually existed. Accordingly, we find that it was sometimes mentioned incidentally, as if unworthy of particular remark, as when the observer says at Richmond, "they appeared to be extinguished in an azure belt that encircled the horizon." Two facts highly interesting in themselves, and not altogether unconnected with the atmospheric origin of the meteors, may be mentioned here, as they have not been yet published.

At Fort Gibson, General Arbuckle, after describing the phenomenon as a shower of fire, consisting of innumerable meteors, many of which were more than fifty times the usual size, and as being so bright that every thing could be seen almost as distinctly as in daylight, goes on to say, that *this brilliant display at no time continued more than two or three minutes at once, when night resumed its usual darkness, for about thirty or forty seconds, and in this order of succession, was*

* See Silliman's Journal, vol. 14, and Jour. of Frank. Inst. vol. 13, p. 366.

this grand exhibition witnessed from its commencement, fifteen or twenty minutes after three o'clock, until daylight.

I would here observe, that there is a remarkable similarity in the facts here described, to what Professor Bache and I frequently saw last August, when we were watching for meteors simultaneously, on many different nights, at the distance of four miles apart, for the purpose of ascertaining their height; we frequently noticed, that after an interval of many minutes, two or three sometimes, four meteors would appear in rapid succession. With us, however, there was this difference—that immediately after one meteor terminated, another would start from a point near its termination, and shoot off, sometimes at right angles to the path of the previous one, and only in one instance was the latter seen to continue in the same straight line with the former.

The other most remarkable fact which I wish to mention here, is, that at one or two of the military posts far west, *all* the meteors moved horizontally. This will clearly appear from the following facts, when it is considered that if either the point from which they diverged, or the point to which they converged, was in the horizon, according to the laws of perspective, their motions must have been horizontal.

Captain John Stuart, of Fort Smith, gives the following statements of a Sergeant, who, the Captain says, is a very intelligent man, and a sentinel at the guard house.

The Sergeant says, that about one o'clock, the sentinel called him, and told him to look at the stars, which were all falling to the ground. This sentinel says, that the first of the extraordinary appearances which he witnessed, was, that a great number of stars came over him from the south-east, and, as he thought, fell in the woods about a quarter of a mile from him, towards the north-west, which was instantly followed by a cloud of stars, covering nearly the whole heavens, and which appeared mostly to fall to the ground, or disappear in the north-western horizon, at various distances from him. The Sergeant further says, that when he came out of the guard house, the whole heavens appeared to be thickly covered with stars, moving with great velocity from the south-east to the north-west, and tending, at the same time, downward, insomuch as to appear to drop into the woods, at a short distance, or were lost sight of in the north-western horizon. The meteors appeared to him to vary in size, from that of the largest star in the heavens to about twice that size. This appearance continued without intermission from about one o'clock till daylight. Neither of these observers recollects to have seen any of these meteors drop or disappear to the south-east of the zenith. Another sentinel, posted on the river, and who had a view of it for two or three miles, said, that they appeared to him to resemble more falling in large lumps, and that they fell all over the river, and in the woods beyond. Another said, that they appeared to him to resemble clouds of birds, which came from all directions, and concentrated in a lake about a mile north-west of the fort, where he supposed that the most of the stars he had seen during the night, had fallen. Another one said, they appeared to concentrate in the north-west. *One*

thinks they sometimes crossed each other's paths in approaching the north-west.

Here is a mass of evidence, perfectly satisfactory, from plain, unlettered men, not proving, indeed, what they all believed, that the meteors fell to the ground a short distance from them to the north-west, but that *their motions were horizontal.*

How could these meteors have had a celestial origin? Or, if they had, how does their radient, which was in the south-eastern horizon, agree with Mr. Olmsted's?

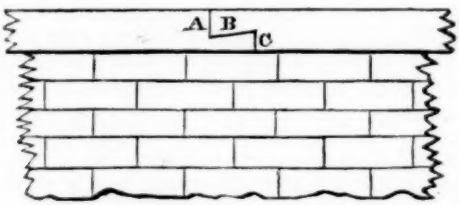
(*To be continued.*)

Expansion and Contraction of Coping Stones.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—The tenth volume of the Journal of the Franklin Institute contains the description of a joint for coping stones, which is stated by the writer to have been found sufficient to protect walls from drip at the joints. The form is figured in the annexed cut, in which A and C are the vertical portions of the joint, and B is a slope connecting them, intended to prevent the water which passes in at A, from obtaining access to the wall at C. This joint is stated to require no cement. It seems to me that such a joint, with or without cement, must prove wholly ineffectual. If the joint be without cement, and as closely fitted at A, B, and C, as the nature of the material will admit, there will be formed very small clefts, through which water will be drawn by capillary action, and will reach the mortar of the wall on which the coping stone is laid. If the joint be made open, to avoid this, the head of the water will enable it to surmount the slope B. If the joint be closed by mortar, the alternate expansion and contraction of the stones will work the mortar loose, and form capillary clefts, similar to those of which I have before spoken. These effects may not render themselves visible at once, but in time must destroy the structure which the coping should protect.

Yours, R. L.



FRANKLIN INSTITUTE.

Monthly Conversation Meeting.

The third conversation meeting of the Institute, for the season, was held at their Hall, Nov. 27th, 1834.

Mr. Thomas Ellicott, of Philadelphia, explained a weighing ma-

chine, and, by reference to a model, a weigh-lock for canal boats, invented by himself; the arrangement of which was judged to be well adapted to the purpose.

A weighing machine, by E. & T. Fairbanks, of St. Johnsbury Plains, Vermont, attracted much attention, and the facility and nicety of its operation were tested and approved.

Messrs. Carr & Lunt exhibited specimens of chisels and butchers' knives, manufactured by I. Russel & Co., of Greenfield, Massachusetts; these were well finished, of approved shapes, and of good quality.

Messrs. Curtis & Hand exhibited a model and specimen of a spring latch for doors, invented by Messrs. Blake, Brothers, New Haven, Conn.; which was admired for its simplicity and apparent durability.

Specimens of rolled sheet-iron handles, for buckets, manufactured by Messrs. Sergeant & Bashford, of Brooklyn, New York, were exhibited; these handles were considered an improvement upon the kind heretofore in use.

Prof. Johnson exhibited and explained models illustrative of the action of the eye, of its parts, and of the mode of vision.

Prof. A. D. Bache gave the particulars of the eclipse of the sun, predicted for the 30th of November, and stated the preparations which had been made, in this city and its vicinity, for observing it.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1834.

With Remarks and Exemplifications, by the Editor.

1. For a *Saw for sawing Staves for Barrels, &c.;* Aaron Bard, and Simeon Heywood, Lunenburg, Worcester county, Massachusetts, July 8.

The saw described is to be in the form of a hoop, made of a diameter corresponding with that of the vessel, to the making of which the staves are to be applied. This hoop saw is to be sustained in its place by a number of rollers fixed in a suitable frame. We think it unnecessary to notice the various appendages which are mentioned, as a machine perfectly similar, and which was patented on the 29th of August, 1833, by Sumner King, of the state of New York, has been described by us at p. 121, of vol. xiii.

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2. For a *Machine for Picking Curled Hair;* John Thompson, 3d, Marblehead, Essex county, Massachusetts, July 8.

(See specification.)

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3. For improvements in the *Crane used for raising and removing heavy bodies;* Hezekiah Bradford, city of New York, July 8.

This crane is principally intended for raising and removing the earth, or other bodies, in excavating the ground for canals and railroads, and it is so constructed that the boom which sustains the load can be made to raise it to a considerable height, and deposit it upon

a bank, in any spot required. The boom is rigged to a mast, and the respective motions are produced through the intervention of tackle. The arrangements have been made with much skill, and, so far as a judgment can be formed from the evidence before us, we see no reason why the apparatus should not operate in a very advantageous manner. The whole description has reference to the drawings which accompany it, and these, indeed, seem absolutely necessary to the understanding of its details.

It is stated that, "by the use of the above machine, a horse, or other animal, and one driver, will accomplish the removal and deposit of a greater quantity of coals, or other heavy bodies, from one spot to another, or to and from a wharf, barge, scow, or other vessel; or remove and deposit in the same manner, from excavations, or in other similar work, a large quantity of earth, or other heavy materials."

"By the arrangements for altering the rake of the mast, I with facility cause the weight that is raised to swing round whilst in the act of raising, and to be carried to the place where it is to be deposited, governing the motion thereof so as to make it more or less rapid, by merely changing the rake of the mast, and the position of the snatch block, so that it shall be further from, or nearer to, the mast. I cause the emptying of the load, or the *dumping*, as it is called by the workmen, to be effected by the same power which raised it, and at the moment at which it arrives at its place of destination."

"I do not claim as my invention, or improvement, the introduction of the use of a crane, or boom, for the purpose of raising and removing heavy bodies; nor do I claim as my invention, or improvement, any of the several parts of the above machine. But I claim as my invention and improvement, the combination in all its substantial parts, and the above described new arrangement and adjustment of the parts of said machine to each other, in such a manner as to produce the above results, when applied to the purposes above specified."

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4. For a *Portable Furnace;* John Lewis, Derby, New Haven county, Connecticut, July 8.

This furnace is of the kind intended for domestic use, and it is to be composed entirely of metal. There are to be four concentric cylinders, the innermost of which is to be of cast iron, with a grate at bottom to sustain the fuel. The other cylinders are to be of sheet iron, and are to have a space between them of half an inch. The outer cylinders are to rise above the inner one, and are also to extend below it. The cylinders are to be kept in their places by screw bolts passing through them, having their heads within the inner, and nuts against the outer, cylinder. These bolts may also pass through pieces, which form feet to the furnace, and the heads of the lower ones may serve to sustain the grate. The patentee claims as his "invention, the construction of a portable furnace, by a combination of cylinders and air chambers, adapted to each other, arranged, and connected, as in this specification is set forth. And I do not claim

any part of the whole instrument, separately taken, or the mode of forming the separate parts, or the use of cylinders or air chambers in general, but only their use and application in the construction of a furnace, as above specified, described, and claimed."

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5. For a *Cotton Whipping Machine;* Samuel P. Mason, Killingly, Windham county, Connecticut, July 8.

The patentee has described this machine entirely by references to the drawings, without putting in any claim to novelty, or designating, in any manner, the difference between it and other whipping, or batting, machines. It operates by means of two horizontal shafts, furnished with fingers, or projecting pins, which play between each other, those passing through one, coming nearly into contact with the other, shaft. There are also some stationary pins, or fingers, attached to the box in which the shafts revolve, serving to aid them in their operation.

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6. For an improvement in the *Construction of Hatters', or other, Kettles;* William Porter, and Abraham Sanger, Waltham, Middlesex county, Connecticut, July 8.

The object of the improvement described is to expose a larger surface to the action of the fire, than is exposed in the way in which such kettles are usually made. The ordinary kettle, which is made conical, is to be surrounded by an annular, or ring-like, vessel, which opens into it below the surface of the contained liquid. The flame is made to play between the conical and the cylindrical parts of the kettle, and around the latter, before it finds its way into the exit flue. The claim is to "the construction of a kettle, or boiler, with different compartments, or flues, as herein described, for the purposes above mentioned."

It would, perhaps, have been more safe to have confined the claim to the particular construction of hatters' kettles, as given in the specification, as there are boilers for steam engines in which the fire operates between concentric cylinders, or vessels of other forms, in a manner very analogous to the foregoing.

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7. For an improvement in the *Fireplace;* Horace Saxton, Erie county, New York, July 8.

This fireplace, or stove, is somewhat in the form of, and is set like, the Franklin stove. The draft, instead of passing through a throat, in the usual way, passes through several holes in the upper back plate; and behind this plate there is an oven, around which the flue passes; there are also holes in the top plate, for cooking utensils. The patentee states that the following constitute his improvements:

"Adding three tiers of holes to the back, to cause a draft for fire and smoke to pass quickly through.—Joining or adding an oven to the fireplace on the upper part of the back side, to be heated from the fire as it passes through holes around it.—Adding the two holes, with

rims, on the top plate, for boilers, or kettles, to be set in. Which improvements only I claim as my invention."

Perhaps the holes in the back plate may be new; but, if so, we do not think them any improvement, as the draft would pass equally well, and probably better, through a narrow throat. The other two points claimed, are mere matters of arrangement, not differing essentially from what has been repeatedly done.

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8. For a *Horizontal Straw and Vegetable Cutter;* Paul Moody, city of Philadelphia, July 8.

The straw, or vegetables, to be cut, are placed in a box, or hopper, in which they descend by their own gravity, so as to come into contact with a revolving blade, extending from the centre to the periphery of a horizontal wheel. The patentee says, "I am aware that simply a wheel, with one or more knives, or cutters, screwed on the arms, in a machine for cutting straw, is no new thing. *But the peculiar* construction of the above described box wheel in a machine for cutting straw, hay, &c. &c., which, with its regulating bottom, or gauge; the mode of fastening the knife and slitters to it, with the application of the latter in the machine to cut vegetables square; and also the apparatus above described for forcing down and compressing hay, straw, &c. &c., is what I claim as my invention and improvement."

Machines similar in principle have been previously patented and described by us; the claim, therefore, should be only for what are called improvements, the general construction belonging to the original inventor, and not being usable without his consent.

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9. For a *Hammer Hatchet;* Joel Howe, Princeton, Worcester county, Massachusetts, July 8.

If to the hammer part of a shingling hatchet, you add a claw projecting back from the hammer face, in a line with the handle, you have this machine.

"The operation of drawing nails is performed by lifting the handle. The hammer drives like other nail hammers.—The invention claimed consists in the combination of the hammer claw with the hatchet, and hammer head and face."

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10. For a *Plough;* James Jacobs, Maysville, Mason county, Kentucky, July 8.

The description of this plough is given, with the precise measurements of the various parts, and with references to lines laid down in the drawings, for the purpose of showing and explaining that particular shape of the mould board, and other parts, which the patentee thinks best adapted to the separation of the furrow slice; and the claim made is to a plough constructed exactly upon the principles described. A description and claim of this kind do not fulfil the requirement of the patent law, that the inventor should distinguish his invention from all things before known or used.

11. For a *Plough;* James Jacobs, Maysville, Mason county, Kentucky, July 8.

This the patentee denominates the "Smeller Plough," and says, "My claim is particularly laid for the formation of my mould board, according to the several lines described on the face thereof, which, by the assistance of the several perpendiculars let fall from them, give those parts of circles, or segments, by or according to the courses of which, the various concavities and convexities of my said board are formed. I also claim the formation of the head and neck, as giving it the advantage of being cast in one piece, with the rest of the mould board, at one operation, without the necessity of a pattern made in two pieces; and more particularly because it allows the holes for the front bolt, and for the brace likewise, to be cast at the same time with the rest."

The casting of the head and neck in one piece with the mould board, is a common practice; the other claims are indefinite.

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12. For a *Filtering Apparatus;* Littleton Ayres, city of Baltimore, July 8.

Water is to be filtered in this apparatus by passing it upwards, by means of hydrostatic pressure, through sponge, charcoal, sand, or other suitable materials; and the claim made is to "the application of hydrostatic balance, or percolation from below, by means of a superior source, either natural or artificial, in combination with gravitation."

Not only has water for domestic use, but rivers for the supply of cities, have also been filtered by "percolation from below, by means of a superior source." A volume might be furnished, by collecting together what has appeared on this subject in the different journals devoted to science and the useful arts. There are three articles in one volume of this journal, either of which will serve to show that there is nothing new in the proposition of the patentee, as, in each of them, the filtering of water by pressing it upwards is the leading principle. We refer to vol. iv., pages 39, 221, and 370.

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13. For a *Self-balancing Slide Valve for Steam Engines;* John Kirkpatrick, city of Baltimore, July 10.

(See specification, p. 203, vol. xiv.)

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14. For an improvement on *Bushing the Sheaves of Pulleys,* and on their pins; Moses H. Marshall, Gloucester, Essex county, Massachusetts, July 10.

Wrought cast steel, of a low temper, is to be substituted for the materials heretofore used for the bush and pin; and in wooden sheaves, strong iron plates are to be let in on each side, and firmly riveted about midway between the centre and rim; these bear against the steel bush which passes through the sheave, and keep it firmly in its place.

15. For a *Traverse Sleigh;* Bela Markham, Burlington, Chittenden county, Vermont, July 10.

The term traverse sleigh is new to us, although, from the tenor of the specification, it seems to be familiarly used in the part of the country where the patentee resides. Judging from the drawing, it appears to be a kind of double sleigh, intended for the carrying of country produce, in situations where a large portion of such articles waits for transportation until the arrival of the sleighing season. The platform, or bed, has under it two sets of runners, which, we suppose, is the usual construction, the things claimed appertaining to other parts of the structure; these we shall not attempt to explain, as we should be compelled to allow more space to the article than would be generally approved.

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16. For a *Thrashing Machine;* Amos and John Wright, Fredricksburgh, Spottsylvania county, Virginia, July 10.

In this machine, the claim is to the combination and arrangement of the several parts; which combination and arrangement differ so little from the same things in many other cylinder and concave thrashing machines, as to render it impossible to point out what is new in them, the patentees having themselves left us in the dark on this subject.

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17. For an improvement in *Railway Carriages;* Isaac Knight, city of Baltimore. First patented March 18th, 1829; patent surrendered, and reissued upon an amended specification, July 10.

We published the specification of this patent at p. 411 of the last volume, and will here remark, that the point embraced in the present specification was one among several contained in that which was surrendered, the others being deemed invalid, or unimportant.

The same mode of sustaining the lateral thrust of the axle which forms the claim of Mr. Knight, was also claimed in one of the patents obtained by Mr. Ross Winans; which of these gentlemen was "the true and original inventor," is not a question for us to determine.

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18. For an improvement in the employment of *Water Power;* Ebenezer Barford, Jay, Oxford county, Maine, July 10.

"The specific, new, and superior facilities comprised in the above described improvement, and which I claim as my own invention, are the following: 1st. The construction of the tub wheel; its peculiar location, being immersed in a reservoir or cistern of water, and consequently not liable to be encumbered with ice; and the manner of its operation, as comprising the wedge power. 2d. The peculiar manner of using the water, so as to double its action upon the terminating wheel, with its full primary force in each action. 3d. The general arrangement and combination of the parts, without specially regarding their size or proportions, or the material of which they are constructed."

Those persons who are well acquainted with hydraulics, will see

enough in the foregoing claims to convince them that the inventor has "travelled out of the record." The idea, which is clearly expressed, that the same water, in the same fall, may be twice used, "with the full primary force in each action," is so manifestly fallacious, as not to require to be disproved; if it can be twice used "with the full primary force," it may be so used a hundred times, and a fall of four feet would be as available as one of four hundred.

In the plan before us, a wheel, with spiral openings near its periphery, through which the water is to descend, is to be placed horizontally in a trunk, or flume; and after it has descended through this, it is to be conducted to an undershot, or flutter, wheel; and the shafts of the two wheels are to be connected by straps, or gearing.

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19. For a *Steam Bug Destroyer;* Jonathan Howlet, Greensboro', Guilford county, North Carolina, July 10.

Woe to the bed-bugs, should these steam bug destroying machines become as numerous as washing, thrashing, and churning machines, of which there seems to be some danger. This is the second from North Carolina, a state by no means prolific in patented inventions. In vol. xiii., p. 313, we described one from the state of New York, and, not long since, there was one from the far west; and, what is somewhat curious, they are all alike, and are also all of them similar to such as had been previously described in the English journals. As the bugs are doomed to destruction, it might be some consolation to them in their dying agonies, to know that their enemies will not be able to sustain the right which they claim to their "infernal machines," under the patent laws, the great seal to the contrary, notwithstanding.

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20. For *Propelling Wheels;* William Kelly, city of Pittsburgh, Pennsylvania, July 10.

Upon the ends of the arms of a paddle wheel, in the place usually occupied by fixed buckets, there are to be quadrangular frames, like the four sides of a box without top or bottom, two sides of which are to act as paddles; these frames are to swing upon pins between the arms, and, it is said, "so long as the frames are in the water, they are held in a position parallel with the surface of the water, by its action on the paddles; and when the frame and buckets leave the water, they are held in the position they are then in, by a guide, or stop, placed on each of the arms, on both sides," &c.

We think but lightly of any of the plans for causing the buckets of paddle wheels to enter and leave the water vertically, or nearly so, as the best of them appear to us to be of doubtful utility; at all events, the best which have been tried, have disappointed the expectations formed of them by their projectors; that now proposed differs from its predecessors, but what advantages it has over them, we are altogether at a loss even to guess.

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21. For propelling machinery by *Horse Power;* Eliakim Briggs, Fort Covington, Franklin county, New York, July 12.

This is the common, inclined, movable floor, upon which the horse is to walk. The cross slats are to be connected together by staples and links on their under sides, which, by their bearing against each other, as the floor becomes straight, are to sustain it, with the horse, or horses, upon it. The doing this by means of the staples and links, is the part claimed as an improvement. There are at least two existing patents for sustaining such a floor, without ways between the drums at the ends; in both these instances, however, blocks, or stops, attached to, and rising to some height above, the upper sides of the slats, were to be brought into contact by the straightening of the floor. This latter method is undoubtedly preferable to that designated in the foregoing patent, but neither of them can be safely depended upon, with the weight of a horse upon the floor, as it is subjected to a leverage which will, sooner or later, cause them to fail.

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22. For a *Chain of Boats*, for inland navigation; Gurdon F. Saltonstall, Darlington district, South Carolina, July 12.

As the title indicates, these boats are to be so constructed that two, three, or more, may be linked together. Those forming the two ends present a sharp bow to the water, whilst the joining ends terminate abruptly, so that, when brought together, and linked, they form one continuous boat. The specification points out the advantages to be derived from boats thus constructed, and the patentee manifestly supposes that the idea of thus connecting boats is altogether new; in this, however, he is mistaken, as will presently appear. He, in fact, seems to think that the whole arrangement proposed by him is original, as he does not make any claim, or attempt to point out in what respect the invention is to be considered as new.

In vol. xii., p. 235, canal boats are described, for which a patent was obtained, April 6th, 1833. Six, or any other number of, sections were to be joined together, the two end sections being so formed as to cause them to pass readily through the water, the others being square, to admit of their being conveniently linked together, just as in the case before us. It is scarcely necessary to go further back, in order to prove the truth of the assertion above made.

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23. For a *Machine for Drawing Boots;* Lewis Dole, and Nathaniel Peckard, Bowley, Essex county, Massachusetts, July 12.

The patentees describe a machine, by means of which the leather, held by proper pincers, is to be drawn with great power over a boot former. There is no claim made, and it is to be presumed, therefore, that the whole contrivance is considered as new. We have described several machines for the same purpose, and were we to add this to the number, we must either procure a cut, or write a page; we therefore proceed to other matters.

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24. For *Locks for Doors;* Simon Pettes, Bellows Falls, Windham county, Vermont, July 12.

The door lock for which this patent is obtained resembles, in several particulars, some which have been previously made the subjects of patents. The bolt and its appendages are not attached to a plate, as in ordinary locks, but are let directly into the door. A hole is to be bored into the edge of the style, to the depth of four or five inches, to receive the bolt, on the end of which there is to be a spiral spring, to force it forward. A slot, or mortise, is to be made in the bolt, at about its middle, and through this the shaft of the knobs is to pass, the slot allowing the bolt to move backwards and forwards. There is a cam, or tumbler, on the shaft, that acts against shoulders in the bolt, which are formed by reducing its thickness at that part. The door is bored through to insert the cam, and other parts; and the opening, thus made, is to be covered, on each side of the door, with brass plates. So far, the operation is only that of a spring bolt, but, in order to give it the effect of a lock, there is a kind of elbow, or bent lever, one end of which is to be operated upon by a key, thus causing the other end to catch against the front shoulder in the bolt, which prevents its being retracted by the knobs. The arrangements made for producing these results, do not appear to be any better than some which have preceded them, neither as regards security, nor simplicity. Without a more particular description of the individual parts, the claims made cannot be perfectly understood; some of them we think rather trifling; they are as follows:

"My claim is to the bolt as above described, and to the manner of moving it backwards and forwards by means of the circular plates; also to the elbow, and the manner of using it to check or secure the bolt when thus locked; likewise to the groove in the shaft, by means of which the handle can move up or down the screw shaft; and to the application of the spiral spring to the end of the long arm, thereby confining it in its situation."

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25. For an improved *Cider Mill;* Nathan Booth, Cheshire, New Haven county, Connecticut, July 12.

This cider mill is to be made in the form of the old-fashioned coffee, or bark mill, with a conical nut, and a shell adapted to it, both of which are to be made of wood, the grooves or spirals upon them being formed by bars of iron fixed upon each, at an angle of about forty-five degrees. These bars are to be an inch wide, and half an inch thick; they are to project their whole thickness at the upper, or feeding, end, but are to be let into the nut and shell, so that, at their lower ends, they shall not rise more than a sixteenth of an inch. The wood between them, at the upper ends, is to be grooved out, so as readily to admit the apples.

The patentee says, "As the basis of my improvement and invention is the old and well known box coffee mill, I claim only as my invention, the use of iron bars to arm wooden cylinders and shells of proper size, with suitable teeth and fluting, to form a strong and durable surface, peculiarly adapted to grinding apples for cider, in the manner above specified."

It would seem to us that a cast-iron nut and shell would be more

strong and durable than that described; and we also think that it could be made at less cost than one of wood, with wrought iron ribs, or flutes.

Against the evidence of experience, we have not a word to urge; but, without the aid of this, we should be apprehensive that the pommage would not readily find its way through the mill, if set so close as is proposed; this, however, does not affect the patent, as the openings may, of course, be made of any required size.

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26. For an improvement in the mode of manufacturing of *Plates for Gun Barrels;* Harvey Mills, Springfield, Hampden county, Massachusetts, July 12.

The plates are to be prepared for welding, by rolling, instead of by forging, as has been usually done. The rollers are to be somewhat more in circumference than the length of the barrel to be formed, and are to be geared together in the ordinary way.

Flat bars are to be employed, of about three-fourths of an inch thick, and wide enough to form the butt of the plate by rolling longitudinally; and in order to give the taper required, both in width and thickness, the bar is first rolled edgewise through eccentric grooves, wide enough to receive it, and is thus reduced to the proper width. It is then rolled flatwise through another groove, or grooves, so formed as to give it the required thickness at the butt, the muzzle, and the intermediate parts. The scarfing is performed in the same way, in suitable grooves, as is likewise the grooving by which it is finally prepared for welding.

The mode of proceeding so as to commence the operation upon each bar at the proper moment, is fully described, and the subjoined claim is then made.

"What I claim as my invention or improvement, is the above described method and process of manufacturing plates for gun barrels, and the manner of engaging and disengaging the rollers, as herein fully set forth and described."

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27. For a *Pump Gauge,* for ascertaining the depth of the water in the hold of a vessel; James D. Woodside, city of Washington, District of Columbia, July 14.

An opening is to be made in the side of a ship's pump, just below the upper band, to receive a small brass box, which may be two inches high, and one and a half wide, and which is to be furnished with a door, to close the opening when the gauge is not in use. A small roller crosses the upper end of the box, and over this passes a tape, graduated into inches and half inches. One end of this tape descends through a casing, nearly to the bottom of the hold, and has a float suspended to it, which will be buoyed up by the water. To the other end of this tape, a counter weight is attached, to take up the slack, by drawing the tape over the roller as the float rises in the water. The patentee says, "What I claim as my improvement, is the vast difference between ascertaining the depth of water in the hold of a

vessel by the ordinary sounding rod, and this instrument;—that the depth is more accurately ascertained, as the vibration occasioned by the rise and fall of the water, owing to the motion of the vessel, is at all times perceptible by the graduated tape; therefore the mean is the correct depth of water in the vessel."

This claim is very awkwardly expressed, as it is not made for the improved instrument as described, but for the vast difference between the result obtained by it, and by the ordinary means used for the same purpose; and this is claiming the effect of a machine, instead of the machine itself.

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28. For a *Washing Machine;* Jesse Gilman, Waterboro', York county, Maine, July 14.

Upon looking at the drawing of this instrument, we supposed that it was intended for grinding, as it is very much in the form of certain mills. It consists of a conical tub, two feet high, and two feet in diameter at the top, within which are to be placed rollers reaching from top to bottom, and turning upon pins in their centres; these rollers are to be two inches in diameter at their upper, and one at their lower, end, and to be nearly in contact with each other. A nut, nine inches in diameter at top, and six at bottom, and having twelve grooves around it, extending from top to bottom, is to be turned by a handle fixed to the shaft, above the nut. "Which machine is of wood, except the pivots, which are of iron."

The suds and clothes are, of course, to occupy the space between the nut and the circle of rollers, and we are not quite sure that a straggling tape, or some unlucky frill, or furbelow, may not become lapped round the rollers, and make unwelcome work for the seamstress; at all events, we have heard such a complaint made against machines furnished with similar rollers. We might urge other objections, but leave them to be discovered by the washerwomen, should the machine ever find its way into their hands.

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29. For an improvement in *Rail-road Cars;* Joseph S. Kite, city of Philadelphia, July 14.

(See report, vol. xiv., p. 385.)

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30. For a *Platform Balance* for weighing; Samuel L. Hay, city of Boston, Massachusetts, July 14.

The platform balance which is the subject of this patent, is suspended, so far as we know, in a manner different from all those which have preceded it. In this machine there are four levers, which are constructed, and operate, like steelyards, two on each side of the platform, attached to it, and to the frame within which it stands. The fulcrum of each lever is fastened to the frame, one end thereof to the platform, and the other to the transfer rod, by which the motion is to be communicated to the graduated steelyard. The four levers which are attached to the platform, have their fulcra at different distances from their ends; the two on one side differing from the two on

the other. In the drawing, the distances, or lengths of the arms in one pair, are as 1 to 10, whilst in the other they are equal, like a scale beam. This is to cause the platform to descend horizontally, whilst these levers operate upon the transfer beam. The claim is to "Suspending a scale, or platform, by four levers, to a transfer beam, in the manner described, for the purpose of weighing."

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31. For a *Bedstead for Invalids;* William Leo Wolf, city of New York, July 15.

This bedstead differs, materially, in its construction, from those ordinarily made for invalids, of which several are patented, and many others described in medical books, most of them bearing a strong resemblance to each other. That before us is intended to be inclined in any direction that may be required; for which purpose, the sacking, or girths, upon which the mattres rests, is attached to a frame placed within the ordinary rails of the bedstead, and is so made that it can be detached from this frame at pleasure. The secondary frame is made to swing on centre pins, passing through the head and foot rails, and on similar ones passing through the side rails, there being other pins to detain it in a horizontal position, or any other in which it may be placed.

By swivelling on the head and foot pins, the patient may have his bed inclined in either direction, provision being made for placing a side board, duly lined and wadded, to support him as the apparatus is turned round. If necessary, the frame upon which he rests can be inverted. When this is to be done, a mattres is placed upon him, over which girths are passed by means of fixtures for that purpose, and a support is provided for his head. When inverted, the original bottom and mattres may be removed, and that and the clothes renewed.

There is no claim made, but the apparatus is, we think, sufficiently characteristic and novel, in its general construction, to be distinguished from all others.

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32. For a *Cooking Stove;* Samuel W. Phelps, Cincinnati, Hamilton county, Ohio, July 16.

The claims made by the patentee are the following:

"1st. The reflecting oven being attached to the stove, and its sides being composed of movable doors, which can be managed to open or shut, to regulate the heat in the oven.

"2d. The small flue from said oven into the smoke flue, which carries off the effluvia of the meats, and prevents their amalgamating flavours.

"3d. The position, plan, and construction, of the furnace and smoke flue, being such as to burn either wood or coal, and the manner in which the front grate may be slid up or down.

"4th. The convenient manner in which all these advantages are combined within a small space, on a simple plan, for the use of families."

33. For a *Rarefying Oven Cook Stove;* Samuel W. Phelps, Cincinnati, Hamilton county, Ohio, July 16.

The following improvements in this stove are claimed as new and useful:

"1st. The flue passing as it does out of the back of the oven, whereby the back of the oven is heated, and room is left at the side and end of the furnace for reflectors.

"2d. The bottom and back plates of the oven are made thinner than the other sides thereof, in proportion to their distance from the source of heat, and thus each side of the oven becomes equally heated at nearly the same time.

"3d. The air chamber interposed between the furnace and the oven.

"4th. The convenient combination of these advantages in the most condensed and suitable form for the use of steamboats and hotels, &c."

There is, in general, so little of new invention manifested in cooking, or other, stoves, and their number is so great, that we rarely think it necessary to give the particulars of their construction, as this, in general, is a mere matter of arrangement. When there is any thing which appears to be really new, we endeavour to make it known, and more than this but few of our readers would desire. We have passed over the two stoves, just noticed, by merely abstracting the claims, some of which most certainly could not be sustained, in their individual characters; but we have thought proper to leave them without animadversion.

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34. For a machine for *Cutting Laths;* Dana Hubbard, Wheeling, Ohio county, Virginia, July 18.

A plank, of about eight feet in length, is to be fixed so as to slide backward and forward, horizontally, in grooves made for that purpose, in a strong bench or frame. The plank is to receive its traversing motion of about eight inches, from a pitman, or shackle bar, attached to one end of it, which is acted upon by a crank on a fly wheel shaft. A knife, the full length of a lath, and from four to six inches wide, is to be fixed upon the sliding plank obliquely, making an angle of about twenty degrees with the edge thereof. The stuff to be cut is first sawed into boards, and then cross-cut to the length of a lath; these boards are dropped edgewise into a groove, falling so as to be cut by the knife, the board bearing against a cutting block, faced with steel on its under side. The laths pass, as they are cut, through an opening made in the plank for that purpose.

The claim is to "the oblique position of the knife, which, together with the sliding of the plank to which it is attached, and the stationary cutting block, produces the compound motion that partly cuts, and partly rives, the lath from the prepared material, with little expense of power."

An oblique position has been repeatedly given to knives for cutting laths, and this, therefore, standing alone, is not the proper subject of

a claim; we think, therefore, that this part might have been advantageously altered; the general construction and arrangement of the machine are, probably, sufficiently novel to justify a patent, although none of its individual parts are new.

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35. For a *Cheese Press;* Sylvester Kibbe, Schoharie, Schoharie county, New York, July 18.

A train of wheels is made to act upon a vertical shaft, which has teeth upon one of its sides, forming it into a rack; upon the bottom of this shaft there is a follower, which is to press upon the cheese. The train consists of three pinions, and two wheels, there being one pinion on the shaft of the crank which is to be turned by hand, and another taking into the rack on the shaft of the second wheel. A weight may be hung upon a lever extending out from the crank shaft, to make continual pressure. The claim is to "the arrangement and combination of machinery, as described, by which the desired effect is produced with the greatest possible ease and expedition."

Those acquainted with machinery will perceive that this is nothing more than the common rack and pinion press; and that, although it is said to act with the *greatest possible* ease and expedition, yet, by the employment of one wheel and two pinions, duly proportioned, the ease and expedition would be still *greater*, as there would be less friction.

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36. For a *Steam Fireplace;* John W. Cochran, Lowell, Middlesex county, Massachusetts, July 18.

The apparatus here patented is intended to heat dwelling houses, ships, and other places, by means of steam generated by a fire in a common open fireplace, or caboose, without interfering with the use of the fire for culinary, or other, purposes.

A boiler of metal is to be made in the form of the back and jambs of an ordinary fireplace. The back part of this boiler is to fit against the back of the fireplace, and its ends against the jambs; it is not, however, we apprehend, to be in contact with them, but at a sufficient distance to allow heated air and flame to pass between them. The height of this boiler, judging from the drawing, will be about equal to that of the breast of the fireplace, and its depth at bottom about a foot, whence it is to slope back as it ascends; it is to have feet at the bottom, to raise it from the hearth. There are to be two long, rectangular cavities in the front, something like ovens, into which the flame is designed to enter, to increase the heating effect, the double plates surrounding these cavities. Water is to be admitted through a pipe at top, and steam is to escape through another pipe, and to be thence conducted around a room, or wherever it may be wanted.

"The said John W. Cochran claims as his own invention, in the above mentioned machine, the application of steam to the heating of dwelling houses, ships, and other places requiring an increased temperature of the atmosphere, by means of a metallic steamer, or

boiler, placedin a common fireplace, stove, or caboose, in such a manner as not to impede the use of the same for all ordinary purposes."

We are very apprehensive that not more than one of these boilers will ever be constructed, and that this one, after having been a source of considerable expense, and more vexation, will be laid by until a more convenient season, which will never arrive. The warming by steam is not quite so simple and easy as was at one time supposed; and had the present inventor made himself acquainted with the history of what has been done and attempted in this way—and had he, moreover, acquired an intimate knowledge of the relationship between steam and heat, we are very sure that he never would have taken his present patent. We cannot here discuss those general principles which belong to this subject, nor indeed can we urge the numerous objections to the plan before us which present themselves; we will observe, however, that the flame of the fire will never find its way into the rectangular cavities, as there is no draft through them, and that, among many other things, we ought to have been informed by the patentee in what manner the boiler is to receive its regular supply of water, what is said upon this point being altogether insufficient.

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37. For a *Bush for Mill Spindles;* Samuel Merchant, Ohio county, Virginia, July 22.

Metallic wedges are to be so placed in the common wood bush as to form a collar around the neck of the spindle, with a piece of gum elastic, or some similar material, between the wood and the metallic wedge, so as to give elasticity thereto, and thus to relieve it, in some degree, from dead friction.

"The improvement which I claim is the simple manner or application of block tin, or metallic wedges, to keep in the wood of the mill bush; and the application of the same, or with the addition of a screw and nut, to other machinery.

"The application of gum elastic, or of some other elastic substance, between the metal and the wood, by which the disadvantages occasioned by dead pressure are prevented.

"The application of the metallic substance for the purpose of relieving from the heat occasioned by the friction of the spindle on the common wood or rope bush, by which means the danger of a mill taking fire by friction is entirely prevented.

"The application of weight, lever, or otherwise, by which the wedge is kept constantly confined at any desired pressure, to the spindle, or gudgeon."

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38. For an *Improvement in Wagons, or other Wheeled Carriages;* Reuben Rich, Albion, Oswego county, New York, July 22.

The specification of this improvement is somewhat laconic, yet the writer terminates his description as though the few remarks made had been productive of some fatigue. The whole which can be called

descriptive, is in the following words: "The wheels are the same as common carriages, except the hubs, and the axles in the hubs. The axle in the hubs is a bar of iron through the hub, with the ends made round, sticking out of the hubs about two or three inches, as the case may be. These axles are made permanent in the hubs, and revolve round with the wheels, and the frame is explained in the drawing; so it needs no further explanation about it."

The said drawings show the wheels, with short axles through them, running in boxes fixed in timbers on each side of them. We have heretofore had occasion to notice such a mode of fixing wheels, and as they were not then new, we apprehend that they must still remain in the same predicament.

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39. For a *Retaining Box for Oil in Upright Journals;* Henry Barton, Rochester, Munro county, New York, July 22.

Below the box in which the upper gudgeon of a vertical shaft revolves, there is to be a cup for containing oil. The box is secured to the frame work by a flanch on its upper side, and descends upon the gudgeon so that a cap fastened upon the shaft, just below the box, may have its sides rise so as to surround the said box, without touching it. The cup may then be nearly filled with oil, which, from the height of the rim of the cup, will necessarily flow in between the gudgeon and the box. When the shaft is to have a rapid motion, this, as the cup revolves with it, would tend, by centrifugal force, to throw the oil out of the cup; a recess, or groove, is, therefore, formed round the lower part of the cup, to retain the larger portion of the oil, and thus to counteract its tendency to overflow.

The advantages derived from the application of the retaining box are stated to be, "first, the effectual preservation of all such bearings from becoming dry, heating, and wearing, and deranging their relative positions, prevent fire from friction, which has not unfrequently been the result of rapid motion. Secondly, a great saving of oil, as the cup saves all that is applied. Thirdly, a saving of time, for, with the addition of the retaining cup, once a week will be often enough to apply oil, when, without it, from once to four times a day is required, in most cases. Fourthly, cleanliness in all fine machinery, as nothing can flow down the shaft, or spindle, to foul or otherwise disfigure or injure below."

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40. For a machine for *Blocking Horse Collars;* Nathan Post, Norfolk, St. Lawrence county, New York, July 24.

Who is the true and original inventor of the mode of blocking collars which is the subject of this patent, it is not for us to say, as we are not furnished with the necessary evidence. The claim made in the present patent, however, is to an apparatus perfectly similar to that described at p. 28 of our last number, and patented by Ebenezer Whitney, of Chenango, Broome county, New York. The only thing claimed in the patent before us, is the drawing of the rope round the collar, when upon the mould, by means of a screw, operating

precisely in the same way with that last mentioned. The block, in the first patent, was to be made of cast iron; but this has nothing to do with the principle of the thing, as this part of the apparatus is in common use.

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41. For a *Regulated Pressure Engine;* Daniel Livermore, Civil Engineer, Blairsville, Indiana county, Pennsylvania, July 24.

This is a very ingeniously contrived hydraulic engine, for applying the power of water to drive machinery, by a regulated pressure. The description of it is of great length, and it was our design to have epitomized it, accompanying our account with the necessary cuts. The article is not, however, yet prepared, and as we anticipate the reception of an account of its actual operation from the inventor, who is engaged in carrying it into practical operation, we shall, for a time, postpone the intended publication.

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42. For a *Plough;* Henry Peachey, city of Philadelphia, July 25.

This patent is taken for an improvement in the mould board, which is not very clearly described. Its difference from other mould boards is said to consist in its "being divided into ribs, or separate portions, each rib being placed beyond the others, rising in a gradual curve;" "the number of ribs may vary according to the size of the plough;" "the principle of the mould board receding to raise portions of mould in succession, is the invention and discovery claimed."

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43. For a *Thrashing Machine;* Gideon Hotchkins, Windsor, Broome county, New York, July 25.

Although a very laboured description is given of this thrashing machine, and certain distinct claims are made, there still is not, in our apprehension, any thing presented which is new. The machine is of the cylinder and concave kind, with beaters which swing upon bolts passing through circular heads, in a way that is well known. Among other things claimed, is the frame, which, we are informed, may be of cast iron, or partly of iron, and partly of wood: and we are told of many other variations that may be made in other parts, of which there can be but little doubt, as we believe they have all been actually made, and that more than once.

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44. For improvements in the *Process of Tanning;* Edward S. and Daniel Bell, Smithfield, Jefferson county, Virginia, July 28.

(See specifications.)

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45. For a *Female Auger for cutting Wagon Spoke Tenons;* John Lenher, Cocalico township, Lancaster county, Pennsylvania, July 28.

Bits for cutting round tenons, or pins, have been long, and well,

known, and have also been used for tenoning spokes for wheels. So far as we can judge from a very imperfect description, there is nothing new in the one which is the subject of this patent; if there is, it consists merely in a change of shape, without the production of any new effect, or the employment of any improved means.

A patent was obtained for an improvement in augers, or bits, of this kind, by Mr. Abel Conant, in June, 1829, as may be seen by turning to p. 176, vol. iv.; at which time it was not pretended that there was any thing new in the thing itself. The plan, as there proposed, we think decidedly superior to that now offered.

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46. For a *Saw Knife;* Lorenzo Graham, Paris, Oneida county, New York, July 29.

Take a common knife, and cut teeth in the back of it, and you have the patent *saw knife*, which, we are told, may be used for culinary purposes, for pruning, or for any thing else which may be found suitable.

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47. For an improvement in the mode of *Chilling Cast Iron Wheels for Rail-road Cars;* Phineas Davis, Civil Engineer, city of Baltimore, July 29.

(See specification.)

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48. For promoting the *Combustion of Anthracite, in Locomotive, and other Steam Engines;* Phineas Davis, Civil Engineer, city of Baltimore, July 29.

(See specification.)

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for a Machine for picking Curled Hair. Granted to JOHN THOMPSON, 3d, *of Marblehead, in the county of Essex, and State of Massachusetts, July 8th,* 1834.

This may certify, that I, John Thompson, 3d, of Marblehead, in the county of Essex, and State of Massachusetts, have invented a new and useful machine for picking curled hair, for stuffing mattreses, chairs, &c., and that the following is a full and exact description of the construction thereof, and the manner of using it.

I construct a suitable frame, in form much like those in general use for cylinder thrashing machines, as the picking is effected between a cylinder and concave, operated upon in a manner bearing some resemblance to those machines. I place an endless feeding apron, horizontally, upon which the hair, curled into ropes in the usual way, is to be placed, and from which it passes between two feeding rollers, the lower one of which carries the feeding apron, and the upper one is borne down by means of weighted levers, or otherwise, so as to

hold the hair rope sufficiently firm to resist the action of the points upon the revolving cylinder and the concave.

The cylinder which I have made, and which answers well, is of wood, two feet two inches in diameter, and about eighteen inches long. It is driven by means of a cog wheel, taking into a pinion on one of its axes, the wheel and pinion being to each other as 7 to 1. Upon the opposite axis there is a whirl, a band from which passes round a band wheel on the axis of the lower feeding roller, which it drives, with a slow motion, the wheel being twenty times the size of the whirl. The cog wheel I turn by means of a crank handle, causing the cylinder to carry the hair upwards, between itself and the concave. This latter is a quadrant of a circle, extending from the feeding apron to the apex of the cylinder; the space between the two being about one and a half inch.

In the cylinder I set rows of pins, made of round wire, and pointed; these project out about an inch, and they are about the same distance asunder; these I place in a line across the cylinder. There may be sixteen such rows, placed in pairs, about three inches apart, so as to make eight double rows. At each edge of the concave, I place similar double rows of pins, leaving the remaining space blank, to admit of the proper stretching of the hair. The pins are so placed, that those on the cylinder pass between those on the concave without touching.

Although I have designated the dimensions of certain parts of this apparatus, I do not intend thereby to limit myself in this particular, as these admeasurements may be departed from, and the particular arrangement varied, whilst the principle of action will remain the same; as, for example, the concave may be placed below the cylinder, and the hair carried downwards; the mode of gearing, also, and the number of rows of pins, &c., may be changed. I do not, therefore, claim the separate parts herein described; but what I do claim as my invention, is the employment of a cylinder and concave, furnished with points, and operating in the manner set forth, by which it is adapted to the picking of curled hair, instead of picking the same by hand, as has heretofore been practised.

JOHN THOMPSON.

Description of certain improvements in the Process of Tanning. Patented by EDWARD S. *and* DANIEL BELL, *Smithfield, Jefferson county, Virginia, July 28th*, 1834.

The objects of the improved modes of procedure for which this patent is obtained, are, *First.* The softening the hides, or skins, and the freeing them from grease. *Secondly.* Expanding the hides preparatory to their receiving the tan. *Thirdly.* The procuring the *tannin*, or tanning principle, from the ooze, pure, by filtering. *Fourthly.* Causing the tanning lixivium more readily to enter the hides, by the use of mechanical compression made upon them, under the surface of the ooze, and thereby shortening the operation.

The claims made are to the modes, and apparatus, adopted for the attainment of these ends. For softening the hides, twenty-one and a half pounds of caustic lime, unslaked, and levigated, and sixteen pounds of carbonate of potash, and one pound of carbonate of soda, are to be added to every two hundred cubic feet of water. In the alkaline liquor thus formed, the hides are to be suspended in the usual way, by which means they will be completely softened, and have their grease neutralized, in from twenty-four to thirty-six hours.

The expanding or raising, of the hides is to be effected by adding to every hundred feet of pure gallic lixivium, one pound of tartaric, and one pound of sulphuric, acids; by suspending the hides in this solution, a complete expansion, it is said, will take place in six or eight hours.

To procure the tanning liquid pure, the ooze, after having been obtained from the bark, is to be filtered by putting it into a vessel of the nature of the common hopper for obtaining ley, the bottom and sides of which are to be covered with about eight inches of raw cotton, and filled in with fine refuse tan, or exhausted bark. Through this the pure tanning liquor is to be passed, and collected in a proper receptacle.

The most important part of the process, however, appears to be the following, namely, the subjecting the hides or skins to mechanical pressure under the surface of the ooze, or tanning liquor. The apparatus employed for this purpose is fully described, and well represented in the drawing. A platform is to be made, and placed upon firm supports, which platform may be situated between two vats containing ooze, and in which the hides are suspended. The platform stands a few inches below the level of the ooze in the vats, which is admitted to flow over it, there being ledges which serve to retain it upon the platform. Upon this platform, the hides are to be submitted to the requisite degree of pressure. The tanning liquid is to be kept, by means of heaters, at a temperature of 98° Fahrenheit. The hides are to be taken from the vats, and spread smoothly upon the platform, and then a kind of carriage, sustained upon two long rollers of wood, or brass, is made to pass over them, the carriage being loaded with such a weight as may be necessary for the skins to be operated upon. The guides, ways, friction rollers, pulleys, &c., which are employed in the moving of this carriage back and forth, we need not describe. The object of this pressure is to remove the watery particles from the pores, which are left there after the ooze has become exhausted by the combination of its tannin with the skin; the pores are thus closed, and the skin condensed, and in that state it is to be slipped again into the vat, without exposing it to the air, where, in the course of six or eight hours, it will again be expanded by the refilling of the pores with fresh ooze. This operation is to be repeated, employing a stronger tanning liquid after the first has produced all the effect expected from it; and thus, in succession, a stronger and stronger, until the process is completed, "which, for heavy leather, takes place in six or eight weeks, and for light skins, in from six to twelve days.

To economize time and labour, there must be a series of such vats and platforms as have been described, thus enabling the workman to proceed readily from a weaker to a stronger solution, these varying according to the nature of the skins; and requiring to be regulated by the judgment of the workman.

Specification of a Patent for an improvement in the mode of Chilling Cast Iron Wheels for Rail-road Cars. Granted to PHINEAS DAVIS, *Civil Engineer, city of Baltimore, July 29th,* 1834.

Whereas, it has been found that, in the casting of what are called chilled wheels, for rail-road cars, that the part of the wheel which is most liable to wear, namely, the rise, cone, or curve, between the tread of the wheel and the flanch, is usually less hard than the other parts, for the obvious reason that the metal is there less rapidly cooled by the chill:

Now, be it known, that I, Phineas Davis, of the city of Baltimore, in the state of Maryland, have invented a new and improved mode of chilling such wheels, in which, by the cooling influence of a hoop, or ring, of wrought iron, made and placed in the flask, or mould, at the time of casting, in a way to be presently set forth, I have succeeded in removing this difficulty; and I do hereby declare that the following is a full and exact description thereof.

Those acquainted with the business of casting iron, are aware that the operation of chilling consists in placing within the mould, so as to make a part thereof, a piece, or pieces, of iron, which, when the metal is poured in, rapidly cools that portion with which it is in contact, and renders it hard. In the casting of wheels for rail-road cars, the chill consists of an iron hoop, of considerable thickness, and with which the whole face of the wheel, including its flanch and tread, is in contact; but from its form, as I have already indicated, there is one part of it, uniting the tread with the flanch, which is less rapidly cooled than the others. To remove this difficulty, I employ what may be denominated an internal chill; this consists of an iron hoop, or ring, which I usually form of round rods, half an inch in diameter, giving to the hoop, or ring, such a diameter as shall cause it, when laid in the flask, and the casting made, to be surrounded by, and completely imbedded within, the cast metal, and to stand about half an inch within the body of that part of the wheel which forms the curve, or cone, before spoken of, and opposite the centre thereof. But as, in the usual thickness of the rims of such wheels, the said ring would be covered on the inside by only a thin shell of metal, I form such a bead, projection, or thickening, opposite thereto, on the inside of the pattern of the wheel, as will cause the metal to cover it, about three-eighths of an inch.

Iron founders are well acquainted with the means of supporting such articles as the before described ring, within the flask, so that they may be embraced within the cast metal. The method which I have adopted of effecting this in my wheels, is the following. I take

four strips of iron, which may be one-tenth of an inch thick, one-fourth of an inch broad, and four or five inches long, and one end of each of these I bend round the ring, so as to clasp it tightly, the remainder of the strap forming a shank, or bearing, which rests upon the sand in the lower flask. These clasps stand at equal distances apart, and, when in the mould, point towards the centre of the wheel. The pattern must be so made, that the parting of the sand in the flask will be opposite to the centre of the ring. Facing sand, of the usual description, should be used in making the mould. The ring, before being placed in the mould, should have its surface made bright, by filing, or otherwise. It must also be heated, say to the temperature of boiling water, to dissipate any moisture, or other evaporable matter, which might otherwise cause it to blow. The casting should be performed immediately after placing the ring in the flask.

Although I have described the mode of procedure in casting, and in other parts of the process for forming wheels within which are imbedded a ring of wrought iron, I do not claim these as making any part of my invention; but I do claim the using of a hoop, or ring, of wrought iron, to be laid, and cast, within the body of a rail-road wheel, in such manner as to operate as an internal chill, to cool more rapidly, and consequently to harden, the part which I have described under the name of the curve, or cone thereof; I claim no more.

PHINEAS DAVIS.

Specification of a Patent for Promoting the Combustion of Anthracite in Locomotive, and other Steam Engines. Granted to PHINEAS DAVIS, *Civil Engineer, city of Baltimore, July 29th,* 1834.

Be it known to whomsoever it may concern, that I, Phineas Davis, of Baltimore, in the state of Maryland, have invented a new mode of promoting the combustion of anthracite, and other fuel, in the furnaces, and fireplaces, of locomotive, and other steam engines, and that the following is a full and exact description of my said invention.

The means by which I promote the combustion of anthracite, or other fuel, is by the employment of fan wheels, or vanes, revolving within drums, in a manner well known to machinists; and my improvement consists in the arrangement of the apparatus by which I employ the waste, or escape steam, to give motion to such fans, or vanes. For a locomotive engine, I usually employ two fan wheels, and I have found them, and their appendages, to answer well in practice, when made of the dimensions which I am about to indicate, although, in this particular, there may be considerable variation, without injury to the effect. The wheels may be from eighteen to twenty inches in diameter, and from ten to twelve inches wide; they may be placed upon the same axis, and at the distance of about eighteen inches from each other in the clear; in many instances, two vanes to each wheel will be sufficient, but a greater number may be used; the drums within which the wheels revolve, do not differ from those or-

dinarily employed in similar blowing machines. The wind is conducted from these drums through tubes seven or eight inches square, which lead from them in the direction of a tangent to the circle described by the wheels, into a tight ash pit under the grate of the furnace; and the air is thereby forced through the fuel with such velocity, as to cause the fire to burn with great energy, so as to produce an abundant supply of steam from anthracite, notwithstanding the tendency of that fuel to pack, and thereby to impede the ordinary draft, when employed for locomotive engines.

In order to give motion to the fan wheels, I place a steam wheel upon the same shaft with them, generally at the centre thereof, so as to be equidistant from them. This steam wheel is constructed in the same manner, nearly, as the wind wheels, differing from them principally in its dimensions, and its being acted upon and impelled by an elastic fluid, (steam,) whilst they act upon and impel an elastic fluid, (air.) The steam wheel has usually four wings, or vanes, from three to five inches in width; and it may be from twenty to twenty-four inches in diameter. This wheel is enclosed within a drum, of such dimensions as just to allow the vanes to revolve freely within it. A tube connected with the exhaust pipe, from each end of the cylinder, enters the drums tangentically, and the waste steam is thus injected forcibly against the extreme ends of the vanes, impelling them, and consequently the wind wheels, with great velocity. The steam which thus enters escapes at an opening, or openings, in the centre of the drum, made similar to those at which the air enters from the action of, and to supply the, fan wheels.

As it is necessary to command the blast, so as to regulate the intensity of the fire, which would often be too great were the whole of the waste steam discharged upon the steam wheel, I attach a branch pipe to that which conducts the steam from the cylinder, or cylinders, to the steam wheel, and employ a valve, or valves, so arranged as to enable me to direct the whole, or any desired portion, of the steam, through such branch pipe, and thus attain the desired object in the most perfect manner.

The continued fresh supply of steam, and the diminished centrifugal force of that which has acted upon the vanes, continues, however, to operate until the moment of its escape at the opening surrounding the centre, provided the parts are properly proportioned to each other, for although its energy is diminished, so also is the actual velocity of the vane, as the centre is approached.

The opening in the steam wheel, for the escape of steam, I usually make on one side only, and cover this with a cap, or drum, and from this cap, or drum, a tube extends upwards to carry off the steam in such a way that no inconvenience may be experienced by its discharge.

Although I intend always to use the waste steam from the cylinder, or cylinders, it is manifest that steam may be supplied from the boiler, to act upon the steam wheel; but this procedure would not be economical, and would yet be a manifest invasion of my rights.

I am aware that wind wheels, such as I have described, have been

used to supply a blast to the furnaces of locomotive engines; I am also aware that wheels have been propelled by the action of steam upon wings, or vanes, surrounding them; I do not, therefore, claim either of these, singly and separately, as my invention; but what I do claim is the combination and arrangement of the parts such as I have described, by which the waste, or escape steam, is made to act upon vanes revolving within a drum, for the purpose of giving motion to wind wheels, to feed the furnaces of steam engines.

And I do hereby declare, that I have herein explained and set forth what I believe to be the best method of applying the waste steam to accomplish the proposed object, but that I do not intend thereby to confine myself to this precise mode of construction and arrangement, but to vary the same as I may find convenient, whilst I operate upon the same principle, and attain a like end by analogous means.

PHINEAS DAVIS.

ENGLISH PATENTS.

Specification of a Patent granted to HENRY CRANE, *Merchant, and* JOHN YOUNG, *Patent Lock Manufacturer, for their invention of certain improvements in the making, manufacturing, or forming, of Iron Hoops for Casks, and other purposes. Sealed 20th March,* 1834.

These improvements in making, manufacturing, or forming, of iron for hoops for casks, and other purposes, consist in giving to the narrow strips of hoop iron a curved figure; that is, bending the strips of iron from the usual straight form in which they are delivered by the ordinary operation of rolling, into such a curve suited to the diameter of the barrel round which the hoops are intended to bind, as will enable them, when formed, to lay close to the conical or elliptical surface of the barrel. This is effected by a peculiar method of acting upon the strips of iron by means of rollers, in order that such required lengths of iron, when cut off and bent round into the circular hoop shape, may be formed slightly tapering, or as the frustrums of cones.

The method by which this is effected, is by drawing out the bar or rod of iron by rolling, in the first instance, in a heated state, in the usual way, until it has been reduced to nearly the required thickness; we then set the rollers, so that their axles incline at a slight angle from the true parallelism, by which means the peripheries of the rollers will be nearer together at one end than at the other, and the strips of iron being then passed between these inclined rollers, will be necessarily compressed, or formed on one edge thicker than at the other edge—that is, of a wedge shape, if cut in a transverse section. This may be done by relieving the screws which confine the axle at one end, and tightening them at the other end; or the same might be effected by making the grooves and ribs of the two rollers inclined to each other, instead of parallel.

When the strip of iron has assumed this wedge shape, in its transverse sectional figures, we then pass it, in its heated state, between a pair of parallel rollers, which, by pressing principally the thicker part of the substance of the strip of iron, causes that thick part to expand and elongate more than the thinner part of the strip, and, consequently, to extend or elongate the strip more on one edge than on the other.

This mode of operation will cause the strip of iron, as it is discharged from the parallel rollers in the last instance, to assume the form of a regular curve, and which curve may be varied to suit any required diameter and inclination of the surface of the cask, or barrel, by varying the inclination of the rollers, or the bevel of the groove, by which the strips are compressed into the wedge shape, that is, thicker on one edge than on the other; and in order to prevent the strip of iron from bending into irregular curves, as it passes in its heated state from the rollers, we have found it useful to place a curved guide, or conductor, near the rollers, which will enable the workman, as he draws out the strip of iron from the rollers, to preserve its desired figure with great accuracy.

Lastly, we wish it to be observed, that as the rolling of iron for the purpose of bringing it into thin and narrow strips for the manufacture of hoops, is not new, of course that process is not to be considered as claimed by us; but the taking of strips of iron, previously made thicker on one edge than on the other, and passing them between parallel rollers, for the purpose of expanding the metal on one side of the other side more than on the other side, and thereby giving to the strip a curved figure as it is discharged from the rollers, being, to the best of our knowledge and belief, new, and never before employed by any other person, or persons, in the manufacturing of hoops, we claim that mode of operation as our invention, and forming the essential feature of our present patent right.

[*Lond. Journ.*

Specification of a Patent granted to FREDERICK STEINER, *Manufacturing Chemist and Turkey Red Dyer, in consequence of a communication from a foreigner residing abroad, for an invention of a certain process, or processes, by which spent madder, or madders, that have been previously used, can be made to yield a great quantity of colouring matter; and for dying with the same, in various colours, all descriptions of cotton, linen, wool, silk, or any mixture of them; and also for improving for dying, madders that have not been previously used. Sealed 2d June,* 1832.

The object of the patentee is to partially restore the property of madder, that is, madder which has been used for dying the colour called Turkey red. When the colouring matter has been extracted from the madder by the ordinary process employed for that purpose,

and it is in a state called spent, the spent madder is then to be mixed with a solution of weak sulphuric acid, that is diluted by water; which acid, by acting upon the vegetable fibre, will revive its red colouring properties.

Other acids may be employed for this purpose, or salts having an acid base; and when the acid has acted sufficiently upon the madder, a quantity of pure water is to be poured upon it, for the purpose of taking up the acid. This water is to be drawn off from the surface, and fresh water introduced several times, until the acidity is completely removed.

The colouring property of the restored madder will be about one-third of that which it originally gave out by the ordinary process of extracting, and it may be either dried, or used in its wet state; the latter of which is preferred, as causing less trouble.

The colour extracted from the restored madder will be fugitive in all articles but cotton; for other goods, it may be rendered permanent by the addition of nutgalls, or other astringent and tanning matter.

Observing these provisions, goods of every kind may be dyed by the restored madder, using about three times the quantity which would be required if the madder was fresh; the same means being resorted to in preparing the goods, which are commonly adopted in dying such articles; and the colouring property of madder in its fresh and unused state may be greatly improved by treating it with acid in the same way as spent madder. [*Ibid.*

Specification of a Patent granted to JOHN PAUL NEUMANN, *Merchant, for certain improvements in making or producing leather from hides, and other skins, being a communication from a foreigner residing abroad. Sealed December* 31*st*, 1833.

The novelty of this invention consists in employing the hop plant, whether root, stalks, or leaves, or any part thereof, to be used by itself for the purpose of tanning, or in conjunction with any vegetable substance or material containing tanning matter. The patentee states that the mode which he chiefly prefers using this plant for the purpose of tanning, is to grind or reduce it to as fine a powder as practicable; and when so prepared, it may be employed for every mode of tanning, in the same manner as bark, or any other vegetable tanning material, according to circumstances, to suit different hides or skins. This tanning matter may be applied either warm or cold, whether in extract, or mixed with other matter; the practical tanner will soon perceive the mode which is most applicable for the different hides, or skins, which he means to subject to the process of tanning, for different hides and skins require different modes of treatment. With some, it is necessary to use heat, or warmth, and others should be tanned cold; but he prefers having the hides, or skins, prepared in the usual mode hitherto followed by practical tanners.

The principal novelty in this invention consists, as before stated, in using the hop plant for tanning, which has never before been em-

ployed for that purpose, and, by means of this process, it will be rendered more extensively useful and valuable. [*Ibid.*

¶ TANSLATIONS FROM FOREIGN JOURNALS.

Extract of a Report upon the employment of Hot Air in smelting Iron with Charcoal. By M. E. GUEYMARD, *Engineer in Chief of Mines.**

A successful experiment in the smelting of iron by the aid of the hot air blast, has been made at the furnace of Rioupéroux, (Department of Isere.) In this furnace, the distance from the blowing machine to the tuyere was insufficient for the erection of the apparatus for heating the air which the machine furnishes; they were obliged, therefore, to make the conduit pipe semicircular.

Six kilns, or ovens, were made with one chimney, 54½ feet (French) high, placed against the stack of the furnace. The fuel used in them was anthracite, which was applied to heat a pipe eight inches in diameter, and ten feet long; the part of the tube which traverses the fire was protected by a coating of fire clay, one inch thick, covered by a shield of cast iron, which received the direct action of the fire.

Five months' work have proved the efficacy of this arrangement; the expense of the construction of the apparatus for heating, including a tube for water, amounted to the sum of 5,009 francs, (1,001 dollars.)

Upon the blast pipe, and close to the tuyere of the furnace, is placed an air gauge, and a thermometer. The consumption of fuel by the air oven has been fixed at 150 kilog. (300 lbs.) of anthracite in twenty-four hours.

The experiments were commenced on the 3d of April; the fires were lighted in succession, and, on the 15th of May, five of them being lighted, the temperature of the air was raised to 125° R., (313° Fah.) and even as high as 130° R., (324° Fah.)

Before the introduction of hot air, the furnace was charged each time with 65 kilog. (130 lbs.) of soft charcoal, and with 77 litres (2¾ cubic feet) of ore.

Gradually the hot air was introduced, the temperature being raised more and more. They have been able to use with the same load of charcoal, quantities of ore increasing as 82, 87, 92, 102, and up to 105, litres; a quantity which has not been exceeded. It was observed that, at this maximum charge, the scoria, or slag, was more liquid, and the metal of a better quality, and finer than before.

The consumption of the five fires was 750 kilog. (1500 lb.) of anthracite in twenty-four hours.

When they worked with cold air, the mouth of the tuyere was eighteen lines (1½ inches) in diameter, and the pressure of the air equalled twenty-four inches of water. Upon the introduction of the hot air, the diameter of the mouth was increased to twenty lines, (1⅔

* Translated by request of the Committee on Publications.

inches, and the pressure decreased to twenty inches. The number of charges were forty in twenty-four hours, in the first case; but in the second, they could not exceed thirty-four, or thirty-five. Afterwards, having restored the pressure to twenty-four inches, they were enabled to increase the number of charges to forty.

The economy of fuel by the use of hot air, at the furnace of Rioupéroux, may be estimated by the results of the castings made during the month of June, being about the average of three months' experiments, and about the same with those of the months of July and August.

During the month of June, 57,989 kil. of pig iron were made by the consumption of—

Ore, ...	110,400 litres.
Charcoal, . . .	1,104 charges.

To obtain the same quantity of metal by using the cold air blast, would have required 1,434 charges of the same charcoal.

There was, therefore, a saving of 330 charges, of which the value, at five francs per charge, = 1,650 francs,

Add eight days' work of the workmen, at 19.36 francs, =	154.88		dollars.
		1804.88 =	360.98
Deduct for the expense of heating the air,			
Attendance of fireman,	45		
21,500 kil. of anthracite,	516		
Interest, 10 per cent., on the cost of the heating apparatus,	41.10		
	602.10 =		120.42
	1202.78 =		240.56.

The benefit resulting from the employment of hot air was, for one month, 1202.78 francs, ($240.56,) or 20f. 72, ($4.14,) per 1000 kilog. (20 cwt.) of the casting produced. This is the minimum gain. Since, the general expenses are not given, and refractory mixtures of ores have frequently been used, during the month of June. It must be observed that the saving of 21,450 kilog. (42,900 lbs.) of charcoal, made in the casting, had required a consumption of 21,500 kilog. (43,000 lbs.) nearly an equal weight of anthracite, of which the value is much less than that of charcoal.

The tuyere was burnt through three or four times in twelve hours, an inconvenience which was remedied by surrounding it with water; after which, the working of the furnace became perfectly regular.

The sixth fire having been lighted, the temperature of the air was maintained at 130° R., (324° Fah.) and was sometimes raised above; but no change was found in the working of the furnace, nor could the charge be increased beyond 105 litres ($3\frac{3}{4}$ cubic feet) of mineral, to 65 kilog. (130 lbs.) of charcoal.

The dimensions of the tuyere mouth, and the pressure of the air, were varied, and the results were always inferior to those already stated; so that the maximum effect produced, with the mixture of ores employed, was with a pressure of twenty-four inches of water,

a diameter of tuyere of twenty lines, the temperature of the blast, 130° R. (324° Fahr.) and 105 litres of ore to 65 kilogs. of charcoal.

A mixture of more refractory ores than the preceding, and which could not be smelted with the cold air blast, was reduced with much facility, but the charge of ore could not exceed 100 litres. It should be remarked, that the temperature of the blast, which appeared to give a maximum effect at temperatures not exceeding 130° R., was much below the temperature of melted lead, (604° Fahr.) to which it had been carried in the experiment made at Vienna in a coke furnace.

Remarks on the foregoing by the French Editor.

1. *M. Gueymard* has correctly observed, that unless the air can be heated by the flame which issues from the mouth of the charcoal furnace, those who are not able to procure a cheap combustible for the heating furnace, and continue to work with cold air, must be most unfavourably situated.

Happily, the attempts made in Germany, and the apparatus there contrived, and which has already been imitated in France, have shown that the flame which escapes from the furnace will heat to a proper temperature all the air which is required. It is recommended that at furnaces where charcoal is used, the heat which would otherwise be wasted, shall thus be used instead of the separate apparatus for heating air, thus augmenting the profits of smelting with heated air, by the whole value of the combustible consumed in the fires.

Thus at Rioupéroux, the saving which has been made of 1202.10 fr. will be carried to 1763.78 fr. per month, or to 30 fr. per 1000 kilog. of iron produced in place of 20 fr.

2. The best plan yet presented for heating the air by the flame at the top of the furnace, is the following, which differs a little from that employed at Wasseralfingen, and described by M. Volz. The air required for the blast, is passed through twenty small columns or vertical tubes, four feet long by two inches and a half in diameter, which are placed in a space or oven near the mouth.

By this means, the air is more heated and there is less friction, than by passing it through a long tube horizontally, because the air passes slower and has only four feet to traverse.

The diminution of the resistance to be overcome by the blowing machine is considerable and very important, because the water courses are frequently hardly sufficient, during the summer, to furnish the quantity of air necessary for the consumption of the iron furnaces.

3. The temperature of the air thrown into the furnace of Wasseralfingen, has been raised constantly to 165° R. (403° Fahr.) and often to 210° R. (504° Fahr.) with increased effect.

M. Gueymard, on the contrary, has observed that the production of iron was not augmented by an elevation of the temperature above 130° R. (324° Fahr.)

At Wasseralfingen, with the air heated to a temperature varying from 165 to 210° R. (329 to 400° Fahr.) to produce 1000 kilog. (2000 lbs.) of iron, 1130 kilog. (2260 lbs.) of charcoal was consumed, in place of 1730 kilog. (3460 lbs.) burned when the cold air was used. The weekly production has been carried from 527 local quintals to 734 quintals—equal to 357 metrical quintals, (lbs.)

At Rioupéroux, with the air heated to 130° R. (266° Fahr.) they have consumed, for 1000 kilog. (2000 lbs.) of castings, 1270 kilog. (2540 lbs.) of soft charcoal, in place of 1610 kilog. (3220 lbs.) with cold air.

The differences between the results obtained in these furnaces are not considerable. It is remarked that in both the quantities of charcoal consumed in twenty-four hours, is not augmented, but the charge of coal and the daily produce of casting, has, by the employment of the hot air blast, received a considerable increase.

[*Annales des Mines.*

REPORT

To the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By M. Dufrenoy, *Engineer of Mines. Paris*, 1834.

(Translated for this Journal, by S. V. Merrick.)

Some experiments by Mr. Neilson, Director of the Glasgow gas-works, led him to think that advantage would be gained by previously heating the air to supply the smelting furnace. He communicated his ideas to Mr. Mackintosh, long known for his inventive genius, and they united in undertaking at the Clyde Iron Works, in concert with Mr. Wilson, one of the proprietors of the establishment, a series of experiments to determine this important question.

In the first experiment, the air from the blowing machine was passed through a rectangular trunk of sheet iron, ten feet* long, four feet high, and three feet wide, where it was heated previous to its entrance into the furnace.

Notwithstanding the imperfection of this method, by which the temperature of the air could not be raised above 200° Fahr., it was evident from the experiment that the plan of Mr. Neilson was destined to produce a revolution in the manufacture of iron.

This first apparatus was soon destroyed by the action of the heat, and its renewal being very costly, they substituted a cast iron pipe, having in the middle an enlargement like the bulb of a thermometer.

This second apparatus produced beneficial effects; it lasted much longer, and the temperature of the air was raised by it to 280° Fahr. This increase, though small, produced a visible economy in fuel. Messrs. Neilson, Mackintosh and Wilson then understood the advantages which would result from raising the temperature many hun-

* English.

dred degrees. They abandoned this heating tube, and constructed a new apparatus, presenting a great number of tubes, heated in many points of their length. By this means, the temperature of the air was raised to 612° Fahr., a temperature above that of melted lead.

Though this temperature was much below that required for smelting iron, (estimated at about 1500°) it produced a considerable saving in the consumption of fuel. Another advantage was obtained, of great importance—that of being enabled to substitute crude coal for coke, without injury to the walling of the furnace. The quality of the iron was, on the contrary, improved, and the furnace which produced but little more than half its quantity of No. 1 and half of No. 2, when fed with coke, gave a proportion much greater of No. 1 iron, after the substitution of crude coal. Besides, the consumption of fuel was considerably diminished. This last circumstance was owing, probably, to the fact that the temperature of the furnace becoming higher, it was not necessary to add so great a quantity of flux to ensure the vitrification of the gangue which accompanied the mineral. It is probably owing to this elevation of temperature that coal may be substituted for coke.

The better to judge of the progressive increase of economy obtained at the Clyde Works, in the experiments to be noticed, we give for each of them the different consumptions of coal and flux.

In 1829. The combustion being maintained by cold air—

	t.	cwt.	qr.	t.	cwt.	qr.
Coal. 1. For fusion, three tons coke, corresponding to	6	13	0			
2. For the blast engine	1	0	0			
				7	13	0
Flux					10	2

In 1831. The furnace being in blast with air heated to 450 Fahr., they still burnt coke for the fusion of the metal—

Coal. 1. For fusion, 1 ton 18 cwt., corresponding to	4	6	0			
2. For the heating apparatus	0	5	0			
3. For the blast engine	0	7	0			
				4	18	0
Flux					9	0

In 1833, July. The temperature of the air was raised to 612° F., and crude coal used for fusion—

Coal. 1. For fusion	2	0	0			
2. For the heating apparatus	0	8	0			
3. For the blast engine	0	10	0			
				2	18	0
Flux					7	0

At this last epoch, the employment of heated air had augmented the yield of the furnace more than one-third, and consequently had effected a great saving in labour. In fine, the quantity of air required to maintain combustion in the furnace, was also found to be sensibly diminished. The blast engine of seventy horse power, which was sufficient in 1829 for only three furnaces, was found of ample power for the blast of four.

By comparing the results which will be indicated, it will be perceived that the economy in combustible is in proportion to the increase of temperature. As to the absolute saving, it varies in each furnace according to the nature of the coal, and the care used in carrying on the operation.

In spite of the complete success of these experiments, the introduction of heated air into the iron works encountered great difficulties. It was necessary to conquer not only the power of habit, but the prejudice generally existing, that the coal is sulphuruous, and that its transformation into coke is not only favourable to combustion in the smelting furnace, but that it is indispensable to the making of iron of good quality.

This plan, in use four years in the environs of Glasgow, which it has saved from certain ruin, has scarcely passed the frontiers of Scotland. However, the wonderful advantages which it has produced, have began to triumph over these prejudices, and gradually to extend its use in the different provinces of England. I know of twenty-one works containing sixty-seven furnaces, which work with hot air. In Scotland six; Flintshire one; Derbyshire three; Newcastle-on-Tyne two; Newcastle-under-Line two; Staffordshire five; Pontepool two.—Total twenty-one.

The iron made at these furnaces is generally No. 1, proper for casting the nicest work.

The plan is equally applicable to the metal intended for bar iron. To obtain this quality of metal, it is only necessary to change the proportion of fuel and mineral. The forges upon the *Tyne Iron Works*, near Newcastle—of *Codnor Park*, near Derby—employ for the manufacture of bar iron, none but the pig metal produced in the hot air furnaces.

In most of the establishments cited, the crude coal has been substituted in place of coke. In some works, where this substitution has not yet been adopted, they assured me, as at Monkland Iron Works, near Glasgow, that the temperature of the air was not raised sufficiently to enable them to pass from the manufacture by coke. In some others the quality of the coal being extremely bituminous, as near Newcastle, appeared to be an obstacle to the use of coal in the natural state.

The employment of hot air is not yet introduced into the great works at Merthyr Tidvil, Wales. The small consumption of coal which is employed crude, as I shall indicate at the close of this report, and the high price of the patent, has retarded its adoption—but I have no doubt that this plan will produce in this country a sensible saving in the consumption of fuel.

To appreciate the advantage which results from the employment of hot air, I shall give a statistical view of the works visited. I will describe the apparatus as far as they differ from each other; and I will compare the consumptions and expenses incident to the production of a ton of iron, before the introduction of hot air, and at present. This description will no doubt appear tedious, but in so important a question, and one which may have immense influence upon our forges,

I think nothing should be omitted tending to instruct our iron masters. I will then give some details upon the coals used in these works, and upon the expenses of manufacture in the Welsh works.

Finally, I will terminate the report by a recapitulation of the principal experiments which have been made in France to introduce the use of hot air in the iron works.

Before commencing this description, I should pay a just tribute of acknowledgment to the proprietors of the works which I have visited. Almost all have procured me, with a noble generosity, the means of studying their establishments with advantage. They have shown, in this circumstance, that the sole rivalry which exists between France and England is that of emulation.

[TO BE CONTINUED.]

¶*Report on the Progress and Present State of our Knowledge of Hydraulics as a Branch of Engineering.* *By* GEORGE RENNIE, *Esq., F. R. S., &c. &c.*

(Continued from page 64.)

The first who had the happy idea of applying the law of Coulomb to the case of the velocities of water running in natural or artificial channels, was M. Girard, Ingénieur en chef des Ponts et Chaussées, and Director of the Works of the Canal l'Ourcq, at Paris.*

He is the author of several papers on the theory of running waters, and of a valuable series of experiments on the motions of fluids in capillary tubes.

M. Coulomb had given a common coefficient to the two terms of his formula representing the resistance of a fluid—one proportional to the simple velocity, the other to the square of the velocity. M. Girard found that this identity of the coefficients was applicable only to particular fluids, under certain circumstances; and his conclusions were confirmed by the researches of M. Prony, derived from a great many experiments, which make the coefficients not only different, but very inferior, to the value of the motion of the filaments of the water contiguous to the side of the pipe.

The object of M. Girard's experiments was to determine this velocity, and this he has effected in a very satisfactory manner, by means of twelve hundred experiments, performed with a series of copper tubes, from 1.83 to 2.96 millimetres in diameter, and from 30 to 222 centimetres in length; from which it appeared, that when the velocity was expressed by 10, and the temperature was 0, centigrade, the velocity was increased four times, when the temperature amounted to 85°. When the length of the capillary tube was below that limit, a variation of temperature exercised very little influence upon the velocity of the issuing fluid, &c.

* Essai sur le Mouvement des Eaux courantes: *Paris*, 1804. Recherches sur les Eaux publiques, &c. Devis général du Canal l'Ourcq, &c.

It was in this state of the science that M. Prony (then having under his direction different projects for canals,) undertook to reduce the solutions of many important problems on running water, to the most strict and rigorous principles, at the same time capable of being applied with facility to practice.

For this purpose, he selected fifty-one experiments which corresponded best on conduit pipes, and thirty-one on open conduits. Proceeding, therefore, on M. Girard's theory of the analogy between fluids, and a system of corpuscular solids or material bodies, gravitating in a curvilinear channel of indefinite length, and occupying and abandoning successively the different parts of the length of channel, he was enabled to express the velocity of the water, whether it flows in pipes or in open conduits, by a simple formula, free of logarithms, and requiring merely the extraction of the square root.†

Thus $v = -0.0469734 + \sqrt{0.0022065 + 3041.47 \times G}$,

which gives the velocity in metres: or, in English feet,

$$v = -0.1541131 + \sqrt{0.023751 + 32806.6 \times G}.$$

When this formula is applied to pipes, we must take $G = \frac{1}{4} D K$, which is deduced from the equation $K = \frac{H + Z = H}{L}$. When it is applied to canals, we must take $G = R I$, which is deduced from the equation $I = \frac{Z}{L}$, R being equal to the mean radius of Dubuat on the hydraulic mean depth, and I equal to the sine of inclination in the pipe or canal. M. Prony has drawn up extensive tables, in which he has compared the observed velocities with those which are calculated from the preceding formulæ, and from those of Dubuat and Girard. In both cases, the coincidence of the observed results with the formulæ is very remarkable, but particularly with the formulæ of M. Prony. But the great work of M. Prony is his "Nouvelle Architecture Hydraulique," published in the year 1790. This able production is divided into five sections, viz: Statics, Dynamics, Hydrostatics, Hydrodynamics, and on the physical circumstances that influence the motions of Machines. The chapter on hydrodynamics is particularly copious and explanatory of the motions of compressible and incompressible fluids in pipes and vessels, on the principle of the parallelism of the fluid filaments, and the efflux of water through different kinds of orifices made in vessels kept constantly full, or permitted to empty themselves; he details the theory of the clepsydra, and the curves described by spouting fluids; and having noticed the different phenomena of the contraction of the fluid vein, and given an account of the experiments of Bossut, M. Prony deduces formulæ by which the results may be expressed with all the accuracy required in practice.

In treating of the impulse and resistance of fluids, M. Prony ex-

† Mémoires des Savans Etrangers, &c. 1815.

plains the theory of Don George Juan, which he finds conformable to the experiments of Smeaton, but to differ very materially from the previously received law of the product of the surfaces by the squares of the velocities, as established by the joint experiments of D'Alembert, Condorcet, and Bossut, in the year 1775. The concluding part of the fourth section is devoted to an examination of the theory of the equilibrium and motion of fluids, according to Euler and D'Alembert; and, by a rigorous investigation of the nature of the questions to be determined, the whole theory is reduced to two equations only, in narrow pipes, according to the theory of Euler, showing its approximation to the hypothesis of the parallelism of filaments.

The fifth and last section investigates the different circumstances (such as friction, adhesion, and rigidity,) which influence the motions of machines.

A second volume, published in the year 1796, is devoted to the theory and practice of the steam engine. Previously to the memoir of M. Prony, "Sur le Jaugeage des Eaux courantes," in the year 1802, no attempt had been made to establish with certainty the correction to be applied to the theoretical expenditures of fluids through orifices and additional tubes. The phenomenon had been long noticed by Sir Isaac Newton, and illustrated by Michelotti, by a magnificent series of experiments, which, although involving some intricacies, have certainly formed the groundwork of all the subsequent experiments upon this particular subject.

By the method of interpolation, M. Prony has succeeded in discovering a series of formulæ applicable to the expenditures of currents out of vertical and horizontal orifices, and to the contraction of the fluid vein; and in a subsequent work, entitled "Recherches sur le Mouvemens des Eaux courantes, he establishes the following formulæ for the mean velocities of rivers.

When V = velocity at the surface,
and U = mean velocity,
$U = 0.816458\ V$,
which is about $\frac{4}{5}$ V.

. These velocities are determined by two methods. 1st, By a small water-wheel for the velocity at the surface, and the improved tube of Pitot for the velocities at different depths below the surface.

If h = the height of the water in the vertical tube, above the level of the current, the velocity due to this height will be determined by the formula $V = \sqrt{2\,g\,h} = \sqrt{19.606\ h}$ (metres) $= 4.429\ \sqrt{h}$.

When water runs in channels, the inclination usually given amounts to between $\frac{1}{300}$th and $\frac{1}{800}$th part of the length, which will give a velocity of nearly $1\frac{1}{2}$ mile per hour, sufficient to allow the water to run freely in earth. We have seen the inclination very conveniently applied in cases of drainage, at $\frac{1}{1200}$th and $\frac{1}{1300}$th, and some rivers are said to have $\frac{1}{8000}$th only.

M. Prony gives the following formulæ, from a great number of observations:

If U = mean velocity of the water in the canal,
I = the inclination of the canal per metre,
R = the relation of the area to the profile of its perimeter, we shall have

$$U = -0.07 + \sqrt{0.005 + 3233 \cdot R \cdot I};$$

and for conduit pipes,
calling U = the mean velocity,
Z = the head of water in the inferior orifice of the pipe,
L = the length of the pipe in metres,
D = the diameter of the pipe,
we shall have

$$U = -0.0248829 + \sqrt{0.000619159 + 717.857 \frac{D Z}{L}}$$

or, where the velocity is small,

$$U = 26.79 \sqrt{\frac{D Z}{L}};$$

that is, the mean velocities approximate to a direct ratio, compounded of the squares of the diameters and heads of water, and inversely as the square root of the length of the pipes; and by experiments made with great care, M. Prony has found that the formula

$$U = -0.0248829 + \sqrt{0.000619159 + 717.857 \frac{D Z}{L}}$$

scarcely differs more or less from experiments than $\frac{1}{40}$, or $\frac{1}{25}$. The preceding formulæ suppose that the horizontal sections, both of the reservoir and the recipient, are great, in relation to the transverse section of the pipe, and that the pipe is kept constantly full.*

In comparing the formulæ given for open and close canals, M. Prony has remarked that these formulæ are not only similar, but the constants which enter into their composition are nearly the same; so that either of them may represent the two series of phenomena with sufficient exactness.

The following formula applies equally to open or close canals:

$$U = -0.0469734 + \sqrt{\left(0.0022065 + 3041.47 \frac{D Z}{L}\right)}.$$

But the most useful of the numerous formulæ given by M. Prony for open canals, is the following:

* According to Mr. Jardine's experiments on the quantity of water delivered by the Coniston Main, from Coniston to Edinburgh, the following is a comparison:

	Scots Pints.
Actual delivery of Coniston Main,.....	189.4
Ditto by Eytelwein's formula,.....	189.77
Ditto by Girard's formula,.....	188.26
Ditto by Dubuat's formula,.....	188.13
Ditto by Prony's simple formula,.....	192.32
Ditto by Prony's tables,.....	180.7

Let g = the velocity of a body falling in one second,
w = the area of the transverse section,
p = the perimeter of that section,
I = the inclination of the canal,
Q = the constant volume of water through the section,
U = the mean velocity of the water,
R = the relation of the area to the perimeter of the section;

then 1st, $0.000436\ \mathrm{U} + 0.003034\ \mathrm{U}^2 = g\ \mathrm{I}\ \mathrm{R} = g\ \mathrm{I}\ \frac{w}{p}$;

2dly, $\mathrm{U} = \frac{\mathrm{Q}}{w}$

3dly, $\mathrm{R}\ w^2 - 0.0000444499 \cdot w\ \frac{\mathrm{Q}}{\mathrm{I}} - 0.000309314\ \frac{\mathrm{Q}^2}{\mathrm{I}} = 0.$

This last equation, containing the quantities

$$\mathrm{Q}\ \mathrm{I}\ w \text{ and } \mathrm{R} = \frac{w}{p},$$

shows how to determine one of them, and, knowing the three others, we shall have the following equations:

4thly, $p = \frac{g\ \mathrm{I}\ w^3}{0.000436\ \mathrm{Q}\ w + 0.003034\ \mathrm{Q}^2}$.

5thly, $\mathrm{I} = \frac{p\ (0.0000444499\ \mathrm{Q}\ w + 0.000309314\ \mathrm{Q}^2)}{w^3}$.

6thly, $w = 0.000436 \pm \frac{\sqrt{[(0.000436)^2 + 4\ (0.003034)\ g\ \mathrm{R}\ \mathrm{I}]\ \mathrm{Q}}}{2\ g\ \mathrm{R}\ \mathrm{I}}$.

These formulæ are, however, modified in rivers by circumstances, such as weeds, vessels, and other obstacles, in the rivers; in which case, M. Girard has conceived it necessary to introduce into the formulæ the coefficient of correction = 1.7 as a multiplier of the perimeter, by which the equations will be,

$$p - 1.7\ (0.000436\ \mathrm{U} + 0.003034\ \mathrm{U}^2) = g\ \mathrm{I}\ w.$$

The preceding are among the principal researches of this distinguished philosopher.*

In the year 1798, Professor Venturi, of Modena, published a very interesting memoir, entitled "Sur la Communication latérale du Mouvement des Fluides." Sir Isaac Newton was well acquainted with this communication, having deduced from it the propagation of rotary motion from the interior to the exterior of a whirlpool, and had affirmed that when motion is propagated in a fluid, and has passed beyond the aperture, the motion diverges from that opening, as from a centre, and is propagated in right lines towards the lateral parts. The simple and immediate application of this theorem cannot be made to a jet or aperture at the surface of still water. Circumstances enter into this case, which transform the results of the prin-

* Recherches Physico-mathématiques sur la Théorie des Eaux courantes, par M. Prony.

ciple into particular motions. It is nevertheless true that the jet communicates its motion to the lateral parts without the orifice, but does not repel it in a radial divergency. M. Venturi illustrates his theory by experiments on the form and expenditure of fluid veins issuing from orifices, and shows how the velocity and expenditure are increased by the application of additional tubes; and that in descending cylindrical tubes, the upper ends of which possess the form of the contracted vein, the expense is such as corresponds with the height of the fluid above the inferior extremity of the tube. The ancients remarked that a descending tube, applied to a reservoir, increased the expenditure.* D'Alembert, Euler, and Bernoulli, attributed it to the pressure of the atmosphere. Gravesend, Guglielmini, and others, sought for the cause of this augmentation in the weight of the atmosphere, and determined the velocity at the bottom of the tube to be the same as would arise from the whole height of the column, including the height of the reservoir. Guglielmini supposed that the pressure at the orifice below is the same for a state of motion as for that of rest, which is not true. In the experiments he made for that purpose. he paid no regard either to the diminution of expenditure produced by the irregularity of the inner surface of the tubes, or the augmentation occasioned by the form of the tubes themselves. But Venturi established the proposition upon the principle of vertical ascension, combined with the pressure of the atmosphere, as follows:

1st, That in additional conical tubes, the pressure of the atmosphere increases the expenditure in the proportion of the exterior section of the tube, to the section of the contracted vein, whatever be the position of the tube.

2dly, That in cylindrical pipes, the expenditure is less than through conical pipes, which diverge from the contracted vein, and have the same exterior diameter. This is illustrated by experiments with differently formed tubes, as compared with a plate orifice and a cylindrical tube, by which the ratios in point of time were found to be 41″, 31″, and 27″, showing the advantage of the conical tube.

3dly, That the expenditure may be still further increased, in the ratio of 24 to 10, by a certain form of tube—a circumstance of which he supposes the Romans were well aware, as appears from their restricting the length of the pipes of conveyance from the public reservoirs to fifty feet; but it was not perceived that the law might be equally evaded by applying a conical frustrum to the extremity of the tube.

M. Venturi then examines the causes of eddies in rivers, whence he deduces from his experiments on tubes with enlarged parts, that every eddy destroys part of the moving force of the current of the river, of which the course is permanent, and the sections of the bed unequal; the water continues more elevated than it would have done if the whole river had been equally contracted to the dimensions of its smallest section—a consequence extremely important in the

* "Calix devexus ampliùs rapit."—*Frontinus de Aqueductibus.* See also *Pneumatics* of Hero.

theory of rivers, as the retardation experienced by the water in rivers is not only due to the friction over the beds, but to eddies produced from the irregularities in the bed, and the flexures or windings of its course: a part of the current is thus employed to restore an equilibrium of motion, which the current itself continually deranges. As respects the contracted vein, it had been pretended by the Marquis de Lorgna,* that the contracted vein was nothing else but a continuation of the Newtonian cataract, and that the celerity of the fluid issuing from an orifice in a thin plate, is much less than that of a body which falls from the height of the charge. But Venturi proved that the contraction of the vein is incomparably greater than can be produced by the acceleration of gravity, even in descending streams, the contraction of the stream being 0.64, and the velocity nearly the same as that of a heavy body, which may have fallen through the height of the charge. These experimental principles, which are in accordance with the results of Bossut, Michelotti, and Poleni, are strictly true in all cases where the orifice is small in proportion to the section of the reservoir, and when that orifice is made in a thin plate, and the internal afflux of the filaments is made in an uniform manner round the orifice itself. Venturi then shows the form and contraction of the fluid vein by increased charges. His experiments with the cone are curious, and it would have been greatly to be regretted that he had stopped short in his investigations, but for the more extensive researches of Bidone and Lesbros. M. Hachette, in opposition to the theory of Venturi, assigns, as a cause of the increase by additional tubes, the adhesion of the fluid to the sides of the tubes, arising from capillary attraction.

In the year 1801, M. Eytelwein, a gentleman well known to the public by his translation of M. Dubuat's work into German, (with important additions of his own,) published a valuable compendium of hydraulics, entitled "Handbuch der Mechanik und der Hydraulik," in which he lays down the following rules.

1. That when water flows from a notch made in the side of a dam, its velocity is as the square of the height of the head of the water; that is, that the pressure and consequent height are as the square of the velocity, the proportional velocities being nearly the same as those of Bossut.
2. That the contraction of the fluid vein from a simple orifice in a thin plate is reduced to 0.64.
3. For additional pipes, the coefficient is 0.65.
4. For a conical tube, similar to the curve of contraction, 0.98.
5. For the whole velocity due to the height, the coefficient by its square must be multiplied by 8.0458.
6. For an orifice, the coefficient must be multiplied by 7.8.
7. For wide openings in bridges, sluices, &c., by 6.9.
8. For short pipes, 6.6.
9. For openings in sluices without side walls, 5.1.

* Memorie della Società Italiana, vol. iv.

Of the twenty-four chapters into which M. Eytelwein's* work is divided, the seventh is the most important. The late Dr. Thomas Young, in commenting upon this chapter, says:

"The simple theorem by which the velocity of a river is determined, appears to be the most valuable of M. Eytelwein's improvements, although the reasoning from which it is deduced is somewhat exceptionable. The friction is nearly as the square of the velocity, not because a number of particles proportional to the velocity is torn asunder in a time proportionally short—for, according to the analogy of solid bodies, no more force is destroyed by friction when the motion is rapid, than when slow—but because, when a body is moving in lines of a given curvature, the deflecting forces are as the squares of the velocities; and the particles of water in contact with the sides and bottom must be deflected, in consequence of the minute irregularities of the surfaces on which they slide, nearly in the same curvilinear path, whatever their velocity may be. At any rate, (he continues,) we may safely set out with this hypothesis, that the principal part of the friction is as the square of the velocity, and the friction is nearly the same at all depths;† for Professor Robison found that the time of oscillation of the fluid in a bent tube was not increased by increasing the pressure against the sides, being nearly the same when the principal part was situated horizontally, as when vertically. The friction will, however, vary, according to the surface of the fluid which is in contact with the solid, in proportion to the whole quantity of the fluid; that is, the friction for any given quantity of water will be as the surface of the bottom and sides of a river directly, and as the whole quantity in the river inversely; or, supposing the whole quantity of water to be spread on a horizontal surface equal to the bottom and sides, the friction is inversely as the height at which the river would then stand, which is called the hydraulic mean depth."‡ It is, therefore, calculated that the velocities will be a mean proportional between the hydraulic mean depth and the fall, or $\frac{11}{10}$ths of the velocity per second.

Professor Robison informs us, that by the experiments of Mr. Watt on a canal eighteen feet wide at the top, seven feet at the bottom, and four feet deep, having a fall of four inches per mile, the velocities were seventeen inches per second at the surface, fourteen inches per second in the middle, and ten inches per second at the bottom, making a mean velocity of fourteen inches per second; then finding the hydraulic mean depth, and dividing the area of the section by the perimeter, we have $\frac{50}{20.6}$, or 29.13 inches; and the fall in two miles being eight inches, we have $\sqrt{(8 \times 29.13)} = 15.26$, for the mean proportional of $\frac{11}{10}$ths, or 13.9 inches, which agrees very nearly with Mr. Watt's velocity.

* See Nicholson's translation of Eytelwein's work.

† See my "Experiments on the Friction and Resistance of Fluids," Philosophical Transactions for 1831.

‡ See Nicholson's Journal for 1802, vol. iii., p. 31.

The Professor has, however, deduced from Dubuat's elaborate theories, 12.568 inches. But this simple theorem applies only to the straight and equable channels of a river. In a curved channel, the theorem becomes more complicated; and, from observations made in the Po, Arno, Rhine, and other rivers, there appears to be no general rule for the decrease of velocity going downwards. M. Eytelwein directs us to deduct from the superficial velocity, $\frac{1}{130}$ for every foot of the whole depth. Dr. Young thinks $\frac{9}{10}$ths of the superficial velocity sufficient. According to Major Rennell, the windings of the river Ganges, in a length of sixty miles, are so numerous as to reduce the declivity of the bed to four inches per mile, the medium rate of motion being about three miles per hour, so that a mean hydraulic depth of thirty feet, as stated to be $\frac{2}{3}$ds of the velocity per second, will be 4.47 feet, or three miles per hour. Again, the river, when full, has thrice the volume of water in it, and its motion is also accelerated in the proportion of 5 to 3; and, assuming the hydraulic mean depth to be doubled at the time of the inundation, the velocity will be increased in the ratio of 7 to 5; but the inclination of the surface is probably increased also, and consequently produces a further velocity of from 1.4 to 1.7. M. Eytelwein agrees with Genneté,* that a river may absorb the whole of the water of another river, equal in magnitude to itself, without producing any sensible elevation in its surface. This apparent paradox Genneté pretends to prove by experiments, from observing that the Danube absorbs the Inn, and the Rhine the Mayne, rivers; but the author evidently has not attended to the fact, as may be witnessed in the junction of rivers in marshes, and fenny countries—the various rivers which run through the Pontine, and other, marshes in Italy, and in Cambridgeshire and Lincolnshire, in this country; hence, the familiar expression of the waters being overridden, is founded in facts continually observed in these districts. We have also the experiments of Brunings, in the "Architecture Hydraulique Générale de Wiebeking," Watmann's "Mémoires sur l'Art de construire les Canaux," and Funk "Sur l'Architecture Hydraulique générale," which are sufficient to determine the coefficients under different circumstances, from velocities of $\frac{2}{5}$ths to $7\frac{1}{2}$ feet, and of transverse sections, from 1 to 19135 square feet. The experiments of Dubuat were made on the canal of Jard, and the river Hayne; those of Brunings, in the Rhine, the Waal, and Ifrel; and those of Watmann, in the drains near Cuxhaven.

M. Eytelwein's paper contains formulæ for the contraction of fluid veins through orifices,† and the resistances of fluids passing through pipes, and beds of canals and rivers, according to the experiments of Couplet, Michelotti, Bossut, Venturi, Dubuat, Watmann, Brunings, Funk, and Bidone.

* Expériences sur le Cours des Fleuves, ou Lettre à un Magistrat Hollandais, par M. Genneté. Paris, 1760.

† "Recherches sur le Mouvement de l'Eau, en ayant égard à la Contraction qui a lieu au Passage par divers Orifices, et à la Resistance qui retard le Mouvement, le long des Parois des Vases; par M. Eytelwein."—Mémoires de l'Académie de Berlin, 1814 and 1815.

In the ninth chapter of the "Handbuch," the author has endeavoured to simplify, nearly in the same manner as the motion of rivers, the theory of the motion of water in pipes, observing that the head of water may be divided into two parts, one to produce velocity, the other to overcome the friction; and that the height must be as the length and circumference of the section of the pipe directly, or as the diameter, and inversely as the area of the section, or as the square of the diameter.

In the allowance for flexure, the product of its square, multiplied by the sum of the sines of the several angles of inflection, and then by .0038, will give the degree of pressure employed in overcoming the resistance occasioned by the angles, and deducting this height from the height corresponding to the velocity, will give the corrected velocity.*

M. Eytelwein investigates, both theoretically and experimentally, the discharge of water by compound pipes, the motions of jets, and their impulses against plane and oblique surfaces, as in water wheels, in which it is shown that the hydraulic pressure must be twice the weight of the generating column, as deduced from the experiments of Bossut and Langsdorft; and in the case of oblique surfaces, the effect is stated to vary as the square of the sine of the angle of incidence; but for motions in open water, about $\frac{2}{5}$ths of the difference of the sine from the radius, must be added to this square.

The author is evidently wrong in calculating upon impulse as forming part of the motion of overshot wheels; but his theory, that the perimeter of a water wheel should move with half the velocity of a given stream, to produce a maximum effect, agrees perfectly with the experiments of Smeaton, and others.†

* Hence, if f denote the height due to the friction,
d = the diameter of the pipe,
a = a constant quantity,

we shall have, $f = V^2 \frac{a\,l}{d}$ and $V^2 = \frac{f\,d}{a\,l}$.

But the height employed in overcoming the friction corresponds to the difference between the actual velocity and the actual height, that is, $f = h - \frac{V^2}{b^2}$, where b is the coefficient for finding the velocity from the height.

Hence we have, $V^2 = \frac{b^2\,d\,h - d\,V^2}{a\,b^2\,l}$ and $V = \sqrt{\frac{b^2\,d\,h}{a\,b^2\,l + d}}$.

Now Dubuat found b to be 6.6, and $a\,b^2$ was found to be 0.0211, particularly when the velocity is between six and twenty-four inches per second. Hence we have, $V^2 = \frac{43.6\,d\,h}{0.0211\,l + d}$, or $V = 45.5\sqrt{\left(\frac{d\,h}{l + 47\,d}\right)}$,

or more accurately, $V = 50\sqrt{\left(\frac{d\,h}{l + 50\,d}\right)}$

† The author of this paper has made a great many experiments on the maximum effect of water wheels; but the recent experiments of the Franklin Institution, made on a more magnificent scale, and now in the course of trial, eclipse

The author concludes his highly interesting work by examining the effects of air, as far as they relate to hydraulic machines, including its impulse against plane surfaces, on syphons and pumps of different descriptions, horizontal and inclined helices, bucket wheels, throwing wheels, and, lastly, on instruments for measuring the velocity of streams of water. A very detailed account of the work was given in the Journal of the Royal Institution, by the late Dr. Young. But it is due to MM. Dubuat and Prony to state, that M. Eytelwein has exactly followed the steps of these gentlemen, in his "Theory of the Motion of water in open Channels."

[TO BE CONTINUED.]

¶ *Composition of Chinese Gongs.*

In the *Annales de Chimie* there is the following account of the Chinese process of manufacturing gongs and cymbals, translated by M. St. Julien, from the "Teen-kong-kae-weh," a Chinese Encyclopædia of Arts and Manufactures:—

"The red copper used in making musical instruments must be alloyed with mountain tin,* which does not contain a particle (*literally* a vapour) of lead. In order to make gongs, &c. eight pounds of copper are alloyed with two pounds of tin. If you wish to make little bells or cymbals, the red copper and the tin must be much purer and finer than for gongs.

"When a gong is to be made, it must not be cast in the form it is to have, and then forged with the hammer. You must begin by founding a thick sheet of metal, which must be cut round, and then beaten with the hammer. For this last purpose, the round sheet of metal must be spread upon the ground; and if the instrument is required to be of large size, four or five workmen must be placed around to hammer it. The sheet will spread out and enlarge under the hammer, and its edges will rise up. Then the instrument will begin to emit sounds resembling those of a musical cord. All these sounds proceed from the points which the hammer has struck (*literally* from the points struck by the *cold* hammer.) In the centre of this drum of copper, a boss or round elevation is formed, which is struck, and the blows of the hammer give it the tone. Two tones are distinguished in the gong—the *male* tone and the *female* tone. Both depend upon the rising being less or greater than ought to be given, with rigorous exactness to the boss, according as one or other is desired. By doubling the blows of the hammer, the instrument acquires a grave tone."

M. D'Arcet, in a note upon this translation, observes:—

"The only thing I find correct in this account is the composition

every thing that has yet been effected on this subject. See also Poncelet, "Mémoire sur les Roues Hydrauliques," and "Aubes Courbes par dessous, &c." 1827.

* The Chinese have two sorts of tin, mountain tin, and river tin; both are found in the provinces of Kwang-see.

of the alloy, of which the Chinese author states these instruments are formed. I have analysed seven gongs and twenty-two cymbals, and I have always found in one hundred parts about eighty of copper and twenty of tin. It is true, about five or six years ago, an original letter was communicated to me from a missionary, which stated that gongs contained, besides copper and tin, $\frac{3}{100}$ of bismuth; but the properties of this alloy, and the result of the analysis just mentioned, show that the workman deceived the missionary on this point. I regard, then, as a fact proved, that these gongs and cymbals are composed of an alloy formed with eighty parts copper and twenty tin; but this is far from sufficient to enable us to fabricate these instruments; for this alloy is as brittle as glass, and if it be used as it comes from the crucible, it would be not only impossible to forge it, but even to use such instruments, merely cast with this alloy, without their breaking. This happened to an untempered gong, which was made at the school of Chalons for the King of Prussia, and to the gong at the opera, which, being cracked, was heated in order that it might be mended with silver solder. The alloy of eighty parts copper and twenty of tin, is so brittle, especially when hot, that it may be reduced to powder. This alloy has great density; its grain is very fine, and its fracture almost as white as that of bell metal. Chinese gongs and cymbals, on the contrary, have a small specific gravity, and a fibrous fracture exhibiting the colour of the alloy, of ninety parts copper and ten tin, used for cannon. Fragments of gongs and cymbals, far from breaking under the pestle, are malleable, and may, moreover, be bent till the two sides of the piece form together an angle of 130° or 140° without breaking. It follows clearly from this comparison, that gongs and cymbals cannot be fabricated, as the Chinese author pretends; that it is only by means of some peculiar process, some sleight of hand, that an alloy of eighty parts copper and twenty tin can be employed in this manufacture. The secret consists in tempering the alloy; in fact, when heated to a dull cherry red, and plunged into cold water, it takes instantly all the physical characters of the gong and cymbals. I have manufactured by this process upwards of sixty pairs of cymbals, and experience has fully justified what I have stated.

"Nothing is said in the Chinese account about tempering, yet, without this operation, it is impossible to fabricate these articles. As to the mode of making them, the alloy of eighty parts copper and twenty tin, even when tempered, cannot possibly be forced, and especially beaten out. All the Chinese author says about casting the alloy in the form of a plate, and beating it out with the hammer, is a mere fiction imposed upon him by a Chinese artificer, just as our artificers endeavour to mislead curious visiters in our manufactories. The following method is, in my opinion, the true one:—

"The model of the instrument is forged in red copper or brass. To this model is given exactly all the desired forms, by making the face of the hammer penetrate more or less on the two surfaces, so as to form that continuity of spherical hollows and salient parts we see upon cymbals, and especially gongs. When the model is finished,

it is employed to make a mould in sand, in putty, or in metal. An alloy of eighty parts pure copper, and twenty of fine tin, is prepared, which is run into an ingot; it is then re-cast, and run into the mould. The piece, when taken out of the mould, is rough-scraped; it is tempered as is done with steel. If it is mis-shapen, by plunging it red hot into cold water, the shape may be rectified by the hammer, and by flattening it with gentle blows. The required tone may be given either at first, by forcing the temper more or less, or afterwards by hammering. It is polished by means of a lathe, as is done with saucepans of copper or brass, and the instrument is finished."—*Asiatic Journal.* [*Lond. Mech. Mag.*

¶ *Biographical Notice of the late Thomas Telford, Esq.*

Mr. Telford departed this life on the second of the present month, (September, 1834,) and his remains were deposited in Westminster Abbey on the tenth instant.

He was a native of Langholm, in Dumfriesshire, which he left at an early age. His gradual rise from the stonemasons' and builders' yard to the top of his profession, in his own country, or, we believe we may say, in the world, is to be ascribed not more to his genius, his consummate ability, and persevering industry, than to his plain, honest, straight-forward dealing, and the integrity and candour which marked his character throughout life.

His works are so numerous all over the island, that there is hardly a county in England, Wales, or Scotland, in which they may not be pointed out. The Menai and Conway bridges, the Caledonian Canal, the St. Katherine's Docks, the Holyhead roads and bridges, the Highland roads and bridges, the Chirke and Pont-y-cisilte aqueducts, the canals in Salop, and great works in that county, of which he was surveyor for more than half a century, are some of the traits of his genius which occur to us, and which will immortalize the name of Thomas Telford.

We know that he was inclined to set a higher value on the success which has attended his exertions for improving the great communication from London to Holyhead, the alterations of the line of road, its smoothness, and the excellence of the bridges, than on the success of any other work he executed; but it seems difficult to draw a line of distinction with any thing like nicety of discrimination, as to the degree of credit to which an engineer is entitled for ingenuity to plan, and the ability to execute, magnificent and puzzling improvements on the public communications of a great country. The Menai bridge will probably be regarded by the public, as the most imperishable monument of Mr. Telford's fame. This bridge over the Bangor ferry, connecting the counties of Carnarvon and Anglesea, partly of stone and partly of iron, on the suspension principle, consists of seven stone arches, exceeding in magnitude every work of the kind in the world. They connect the land with the two main

piers, which rise fifty-three feet above the level of the road, over the top of which the chains are suspended, each chain being 1,714 feet from the fastenings in the rock. The first three masted vessel passed under the bridge in 1826. Her topmasts were nearly as high as a frigate; but they cleared twelve feet and a half below the centre of the roadway. The suspending power of the chains was calculated at 2,016 tons; the total weight of each chain is 121 tons.

The Caledonian Canal is another of Mr. Telford's splendid works, in constructing every part of which, though prodigious difficulties were to be surmounted, he was successful. But the individuals in high station, now traveling in the most remote part of the island, from Inverness to Dunrobin Castle, or from thence to Thurso, the most distant town in the north of Scotland, will there, if we are not mistaken, find proofs of the exertion of Mr. Telford's professional talent, equal to any that appear in any other quarter of Britain. The road from Inverness to the county of Sutherland, and through Caithness, made, not only so far as respects its construction, but its direction, under Mr. Telford's orders, is superior, in point of line and smoothness, to any part of the road of equal continuous length, between London and Inverness. This is a remarkable fact, which, from the great difficulties he had to overcome in passing through a rugged, hilly, and mountainous district, incontrovertibly establishes his great skill in the engineering department, as well as in the construction of great public communications.

These great and useful works do not, however, more entitle the name of Telford to the gratitude of his country, than his sterling worth in private life. His easiness of access, and the playfulness of his disposition, even to the close of life, endear his memory to his many private friends. [*Rep. Pat. Inv.*

¶ *On the Resistance of Hollow and Solid Cylinders.*

If this question were proposed—which of two sticks, equal in length and cylindrical, is the easiest to break upon the knee—that which is entirely solid, or that which is hollow, having the same quantity of matter with the other? Most people would not hesitate to decide that the hollow stick would be the easiest to break. Nevertheless, the fact is quite the contrary. When we rest a stick upon the knee to break it, we rest it by some one of its points, and it is the point diametrically opposite which will take a circular motion about the point of support, while the fracture is made. Here, then, is a lever, and this point, which moves circularly, describes an arch so much the greater, as it is further distant from the point of support, or from the fixed point, and consequently, it has so much more force to resist the power which tends to make the fracture. A thicker cylinder, if solid, is the more difficult to break, not only because it contains more matter upon which we must act, but also because the diameter of its base is greater, and the extremity of its diameter, which moves in the fracture, is further distant from the fixed point.

If this cylinder, preserving the same quantity of matter, were hollow, it is visible that its total diameter, that is, the diameter as well of the hollow part as of the solid, would necessarily increase, and consequently only one of the causes which made its force and its resistance against being broken. Every hollow cylinder is, then, stronger than a solid cylinder, which has only the same quantity of matter; and this, according to all appearance, is one of the reasons why the bones of animals and the culms of corn and grass are hollow.

Galileo, the first philosophical inquirer into matters of this sort, has considered, in the solid and hollow cylinders, having their bases formed of the same quantity of matter, only the inequality of their diameters; and consequently, he has established, that the resistance of a hollow cylinder is to that of a solid cylinder, as the total diameter of the hollow one is to the diameter of the solid one. But this consideration is imperfect in this, that the extensions of the fibres of which the cylinders are composed, are not taken into account. These extensions, and consequently the resistances of all the particular fibres, continually increase from the fixed point to the most distant fibre, which must break first, and which we may suppose, is the greatest extension that it can suffer. It is the sum of all these unequal resistances that makes the resistance, which all the fibres together oppose to the power which tends to break them. Thus the total resistance of the cylinder depends upon three things,—on the quantity of matter that composes the base, on the resistance that all these fibres together bring to their extension, and on the magnitude of the diameter of the cylinder. There remains to determine and express geometrically these magnitudes; and it is this that M. Parent has done. The circles of the base of the solid cylinders must be made equal to the bands or zones of the hollow cylinders, and we must find the sum of the unequal resistances of all the fibres, which is a particular case of the general method of M. Varignon.

M. Parent having arrived at a general *formula*, which contains all the possible resistances of hollow cylinders, compared to the solid, has calculated upon this formula, a table, wherein he supposes that the total semi-diameter of a hollow cylinder is always 100 parts; and that the resistance of the solid cylinder, which contains in its base as much matter as the other, is also divided into 100 parts. We see by this table:—

1. That in proportion as the hollow cylinder, of which the *radius* can have but 100 parts of a certain determinate magnitude, has more void, and consequently less matter, it makes a greater resistance than the corresponding solid cylinder.

2. That this inequality of resistance always diminishes in proportion as the hollow cylinder is less hollow, and contains more matter: that, for example, a cylinder, of which the void is 99 *radius* and one in thickness, and which consequently answers a solid cylinder, which is only fourteen *radius*, has a resistance which is to that of the solid cylinder as 848 to 100, that is, as $8\frac{12}{25}$ to 1; and that the cylinder which has 50 in void and 50 in thickness, and which answers to a

solid cylinder of 87 *radius*, has a resistance which is to the solid one only as 121 to 100.

3. That the hollow cylinder of 99 void, the resistance of which, compared to that of the solid one, which is 14 *radius*, would be, according to Galileo, $7\frac{1}{7}$ times greater, has one $8\frac{12}{25}$ times greater according to the hypothesis of M. Parent, which is also that of M. Mariotte.—*Abridged from the Transactions of the Royal Academy of Paris for* 1702. [*Lond. Mech. Mag.*

¶ *On the Effect of Impact on Beams. By* Eaton Hodgkinson.

The author gave the results of some inquiries into the power of beams to resist impulsive forces. The experiments were made by means of a cast iron ball, forty-four pounds weight, suspended by a cord from the top of a room with a radius of sixteen feet. The ball, when hanging freely, just touched laterally an uniform bar of cast iron, sustained at its ends in a horizontal position, by supports under it and behind it, four feet asunder. The intention was to strike the bar, sometimes in the middle, and sometimes half way between the middle and one end, with impacts obtained by drawing the ball and letting it fall through given arcs, shifting the bar when the place of impact was to be changed, and obtaining the deflections of the bar at that place by measuring the depth which a long peg, touching the back of the bar, had been driven by the blow into a mass of clay placed there. The results were:—

1. The deflections were nearly as the cords of the arcs through which the weight was drawn, that is, as the velocities of impact.

2. The same impact was required to break the beam, whether it was struck in the middle, or half way between the middle and one end.

3. When the impacts in the middle, and half way between that and the end, were the same, the deflection at the latter place was to that at the former, nearly as three to four, which would be the case if the locus of ultimate curvature, from successive impacts in every part, was a parabola.

The preceding deductions the author had found to agree with theoretical conclusions, depending on the suppositions, (1) that the form of a beam bent by small impacts was the same as if it had been bent by pressure through equal spaces; and (2) that the ball and beam when struck, proceeded together after impact as one mass. These suppositions likewise gave as below:—

4. The power of a heavy beam to resist impact, is to the power of a very light one, as the sum of the inertias of the striking body and of the beam is to the inertia of the striking body.

5. The time required to produce a deflection, and, consequently, the time of an impact, between the same bodies, is always the same, whether the impact be great or small. The time, moreover, is inversely as the square root of the stiffness of the beam.

6. The results of calculations, comparing pressure with impact,

gave deflections agreeing with the observed ones, within an error of about one-eighth or one-ninth of the results.

[*Report of 3d Meeting of Brit. Assoc. for Advanc. of Science.*

On the Direct Tensible Strength of Cast Iron. *By* E. Hodgkinson.

The absolute strength of this metal, notwithstanding the extensive use made of it in the arts, is still a matter of doubt. If we turn for information to authors, we find Mr. Tredgold and Dr. Robison making it three times as great as Mr. Rennie, or Captain Brown, and the advocate of the greater strength (Tredgold) attributing the less strength, as found by the others, to the straining force not having been kept in the centre of the prism. For, supposing the extensions and compressions to continue always equal from equal forces, (which they are under slight strains,) a small deviation from a central strain would make a great reduction in the strength; and if the force were applied along the side of a square piece, the strength would be reduced to one-fourth. (*Tredgold*, Art. 61, 62. 234.)

The above contrariety of opinion was the cause of the following experiments, in which the utmost care was taken to keep the straining force along the centre of the castings, which had their transverse sections of the form +, except in the last two experiments, in which the section of the castings was rectangular, and the force applied exactly *along the side*. The iron was of a strong kind, the same as in the author's experiments on beams, (*Manchester Memoirs*, vol. v.) and was broken by a machine on Captain Brown's principle for testing iron cables.

Force up the middle.

Experiments.	Area of section in parts of an inch.	Breaking weight in tons.	Strength per square inch in tons.
1	3.012	22.5	7.47 } tons.
2	2.97	21.0	7.07 } mean 7.65.
3	3.031	25.5	8.41 }
4	2.95	19.5	6.59 Different quality of iron

Force along the side.

Experiments.	Area of section.	Breaking weight in tons.	Strength per inch.
5	4.83	11.5	2.38 } tons.
6	4.815	13.75	2.855 } mean 2.62

Whence the strength of a rectangular piece of cast-iron, drawn along the side, is rather more than one-third of $7\frac{2}{3}$ tons, its strength, as above found, to bear a central strain (for $\frac{2.62}{7.65} > \frac{1}{3}$,) but from the

preceding remarks, it ought only to be one-fourth; and, therefore, it would appear that a shifting of the neutral line had made the pieces capable of bearing a greater force along the side than in their natural state. [*Ibid.*

¶ *Notice of a Method of Analyzing Carbonaceous Iron.*

At a meeting of the section of Mathematics and Physics of the British Association for the Advancement of Science, Professor Johnston gave an account of a new method of determining the amount of charcoal in the carbonaceous irons, by which he hopes to obtain results more precise and trustworthy than those arrived at by any former mode. This method consists essentially in reducing the iron to fine powder in a steel mortar, and burning it with oxide of copper. Mr. Johnston expects to be able to lay a series of results before the next meeting of the Association.

[*Ibid.*

¶ *To purify Palm Oil, and to whiten it comparatively for making Soap.*

Take two parts of quick lime, and three parts of the muriate of ammonia, the lime having been previously slacked with half its weight of water, and allowed to cool, and reduced to a fine powder, and the muriate of ammonia having also been reduced to a fine powder, and then intimately blended with the powdered lime. The mixture is to be put into a still, or cast-iron pan, having a close cover to it, and a tube leading from the head of the pan, or still, to near the bottom of the soap copper, which should contain equal quantities of water and palm oil. On fire being applied to the still, the ammoniacal gas will pass over into the soap copper; and as the water and oil combine, continue adding boiling water to the extent of treble the weight of the palm oil in all. By this process, the colour of the palm oil will be almost instantaneously changed to a pale yellow. The boiling palm oil and water should, of course, be kept rapidly stirring while the gas is passing through. The ammonia being an alkali, adds to the strength and detergency of the soap, while the peculiar smell imparted by it is so weak as scarcely to be susceptible after a few days' exposure to the atmosphere.

[*Lond. Mech. Mag.*

¶ *Patents issued in England.*

The whole number of patents for inventions granted in England, from the beginning of the year 1820, amounted to *one thousand four hundred and forty-one;* and of these, from accident, or other causes, known only to the patentees, the specifications of seventy-one have not been enrolled in chancery, as directed in each grant; consequent-

ly, no accounts of those inventions can be given. The patent rights, in those instances, have become null and void.

The following are the numbers of patents granted in the several years:

1820	granted	95	Specifications not enrolled		7
1821	"	115	"	"	5
1822	"	106	"	"	4
1823	"	136	"	"	2
1824	"	179	"	"	8
1825	"	247	"	"	15
1826	"	131	"	"	7
1227	"	150	"	"	6
1828	"	152	"	"	6
1829	"	130	"	"	11

[*Lond. Journ.*

List of American Patents which issued in December, 1834.

A desire has been repeatedly expressed by persons interested in patents, that a monthly list should be published, bringing them up, as near as may be, to the period of publication. The editor has not thought it proper to publish his animadversions immediately after patents are obtained, that patentees might not charge the want of success of their inventions to the free remarks which he is in the habit of making upon them; such publications might also be injurious to those who wish to secure patents in Europe. These objections, however, do not lie to the mere titles of patents, and the names of patentees.

Dec.

571. Propelling boats by a screw.—William Burk, Whitemarsh, Pa. 2
572. Saw mill dogs.—Phineas Bennet, Hector, New York, 2
573. Movable links.—Peter Barthlemy, New York city, 2
574. Cleaning grain, &c.—M. N. Armstrong and Wm. R. King, N. Y. city, 2
575. Moulding bricks.—Wm. C. Grimes, York, Pennsylvania, 2
576. Pressing bricks.—Wm. C. Grimes, York, do. 2
577. Carry-all.—Frederick Shelton, Jackson, North Carolina, 2
578. Nail and spike machine.—Henry Burden, Troy, New York, 2
579. Spinning reel.—Samuel M'Cawley, Fallston, Pa. 2
580. Making pitch.—Henry Ruggles, New York city, 2
581. Circular tenter bars.—Stephen R. Parkhurst, Meriden, Rhode Island, 2
582. Fireplace and stove.—Elias W. Newton, Middletown, Conn. 3
583. Tracks and wheels for rail-roads.—Ed. C. Hyde, Natchez, Miss. 3
584. Side saddle.—Olney Briggs, Schoharie, New York, 3
585. Covering ropes with caoutchouc.—Patrick Mackie, New York city, 3
586. Press for cotton, hay, &c.—I. Robinson, Portland, Maine, 17
587. Removing weights, unloading boats, &c.—Thomas Potter, Bowling Green, Kentucky, ... 17
588. Mortising machine.—J. H. Chandler, Worcester, Mass. 17
589. Wave motion for roving cotton.—L. Brewster, Poughkeepsie, N. Y. 17
590. Easy chair.—B. F. Hays, Pittsfield, Massachusetts, 17
591. Bedstead.—P. Humphreville and J. King, Morristown, N. J. 17
592. Thrashing machine.—C. P. Tenant and W. Eaton, Wooster, Ohio, 17

		Dec.
593.	Smelting iron ore. Thomas J. Ridgway, Pottsville, Pa.	17
594.	Corn sheller.—Warren Johnson, Boscawen, N. H.	17
595.	Cooking stove.—James Childs, Henniker, N. H.	17
596.	Stone hammers, making.—G. H. Pierce, Middleburgh, Mass.	17
597.	Lath machine.—S. and C. Howard, Bristol, Mass.	17
598.	Lay for power looms.—Benj. Brooks, New Market, N. H.	17
599.	Washing machine.—Wm. C. Kniffin, Alexander, New York,	17
600.	Corn planter.—Thacker O. Bush, Clark co., Kentucky,	17
601.	Dressing staves.—Asahel Fairchild, Queensbury, N. Y.	17
602.	Ovens.—Samuel S. Eaton, Mansfield, Connecticut,	17
603.	Sheet and boiler iron.—John M'Nary, Brooklyn, New York,	17
604.	Scythes.—Augustus H. Searle, Indianapolis, Indiana,	17
605.	Thrashing machine.—Webber Furbish, Hallowell, Maine,	17
606.	Ovens.—Benjamin Blaney, Boston, Massachusetts,	17
607.	Cotton seed, hulling.—C. Beck annd W. Jenks, Columbia, S. C.	17
608.	Wrought iron nails, &c.—Wm. C. Grimes, York, Penn.	17
609.	Making do. from rods, &c. do. do. do.	17
610.	Applying heat.—John C. Douglass, New York city,	23
611.	Brick machine.—Daniel Wolfe, Mount Vernon, Ohio,	23
612.	Mooring machine.—Enoch Amblers, Root, New York,	23
613.	Bellows.—John R. Morrison, Springfield, Ohio,	23
614.	Straw cutter.—Joshua Moore, Roane county, Tenn.	23
615.	Shelling corn.—Ezekiel W. Coffin, Gilead, Maine,	23
616.	Cheese curd cutter.—Isaac Hunter, jr., North Braintree, Mass.	23
617.	Hemp dressing machine.—Chandler E. Potter, Portsmouth, N. H.	23
618.	Stomach pump.—Lemuel B. White, New York city,	23
619.	Splitting palm leaf.—Charles Wadsworth, Barre, Mass.	23
620.	Planing and grooving.—Z. B. Grover and D. Lawton, Springwater, New York, ...	23
621.	Planing machine.—Thomas E. Daniels, Worcester, Mass.	23
622.	Safety lock.—Zibeon Wilbur, Woodbury, Conn.	23
623.	Pattern lathe.—Henry Mellish, Walpole, N. H.	23
624.	Propelling boats.—Isaac Theal, New York city,	24
625.	Bending tire and springs.—Fowler M. Ray, Cattskill, New York,	24
626.	Washing and churning machine.—Nahum Swett, Readfield, Maine,	24
627.	Steel carriage springs.—Lyman Gleason, Stafford, N. Y.	24
628.	Moulding bricks.—Robert Rankin, Frankfort, Maine,	24
629.	Clapboard machine.—Otis and Daniel Parker, Hubbardston, Mass.	24
630.	Horse power.—William Emmons, New York city,	24

CELESTIAL PHENOMENA, FOR MARCH, 1835.

Calculated by S. C. Walker.

Day.	H'r.	Min.				
7	11	51	N. App. ☽ and 121 Tauri,	,6,	☽ S. 0',6	
18	13	32	Im. 42 Leonis,	,6,	N. 103°	V156°
18	14	20	Em.		N. 201°	V254°

Meteorological Observations for December, 1834.

NOTE.—By an accident, the meteorological table for December has not been received in time to appear in the present number.

COM. PUB.